

TRENDS IN CIGARETTE SMOKING AND THE RELATIONSHIP WITH
FAILING TO BE RETAINED IN HIV PRIMARY CARE, 2008-2010

by
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Abstract

Introduction: Currently, there are over a million individuals living with HIV in North America, with over one-third not in HIV primary care and twice as many reporting cigarette smoking as non-HIV-infected individuals. Few smoking cessation programs exist to target this population and little research has been focused on the relationship between smoking and retention in care. The objectives were to describe patterns of smoking in HIV-infected adults by demographic characteristics and to estimate the association of smoking on failing to be retained in HIV primary care.

Methods: Analysis included data from five clinical cohorts from the North American Cohort Collaboration on Research and Design (NA-ACCORD). Adults retained in care during the year of their first visit and who contributed laboratory and smoking data for at least two visits from 2008 to 2010 were analyzed. Smoking status was time-varying and defined as never, ever, or current. Retention in care was defined as ≥ 2 HIV primary care visits ≥ 90 days apart in a calendar year. Trends in smoking statuses were described by characteristics such as age, sex, race, injection drug use (IDU), region of residence, and highly active antiretroviral therapy (HAART) use. Trends in the proportions of never/ever/current smokers were detected using logistic regression models with generalized estimating equations (GEE) using independent correlation matrixes and robust variance estimations. Univariate and multivariate Cox proportional hazard models with the Efron method for ties were used to assess associations between time-varying smoking status and failing to be retained in HIV primary care over the study period.

Results: The sample of 3,575 HIV+ participants were 74% male, 47% African American, 19% IDUs, and 62% Southern US residents. At baseline, 28% were current smokers,

43% ever smokers, and 28% never smokers. 17% of the NA-ACCORD population failed to be retained in care from 2008 to 2010, with a reduced risk among ever smokers (vs. never) (aHR=0.64 [0.50, 0.81]) and no difference in risk among current smokers and never smokers (aHR=0.92 [0.73, 1.17]) adjusting for characteristics.

Conclusions: Programs incorporating smoking cessation into HIV clinical care may help better retain current smokers who are trying to quit.

Advisor: Keri Althoff, PhD

Thesis Reader: Greg Kirk, MD

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Chapter 1: Introduction

Currently, there are an estimated 1.3 million individuals living with HIV in North America (1). Approximately 40 to 63% of HIV-infected adults smoke cigarettes (2-4) with an average consumption of 16-23 cigarettes per day (5 & 6) and an average duration of 22.8 years (7). According to the CDC, tobacco use is the leading cause of preventable disease, disability, and death in the United States and is strongly associated with decreased quality of life and increased mortality among HIV-infected adults (4 & 8).

Even with viral control, HIV-infected adults who smoke have an increased risk for cardiovascular disease, cancer, and pulmonary diseases (9-11). HIV-infection further increases the susceptibility of smokers to chronic obstructive pulmonary disease (COPD), lung, head, and neck cancers (2, 4, 12-14), and respiratory infections such as bacterial pneumonia (16 & 17) and tuberculosis (15). De and colleagues reported a 70 to 100% increased risk of bacterial pneumonia in HIV-infected smokers and cessation reduced the risk of bacterial pneumonia by roughly 27% (16). HIV-infected smokers also report a substantially decreased quality of life (4), lower general health perception, physical functioning, bodily pain, energy, and cognitive functioning compared to HIV-infected non-smokers (17). HIV-infected individuals who smoke were more likely to complain of cough, shortness of breath, wheezing, or chest pain compared to HIV-infected non-smokers (17). Smokers with newly diagnosed HIV-infection are more likely to have a lower CD4 cell count at ART initiation and mount a reduced response to ART compared to newly-diagnosed HIV-infected non-smokers (18 & 19).

1.1 Correlates of cigarette smoking in HIV-infected adults

Among those living with HIV, individuals who reported ever smoking were more

likely to be older (7 & 20), non-white (17, 21, 22), and report greater injection drug use and alcohol consumption compared to HIV-infected individuals who reported never smoking (4, 7, 17, 20, 22). The Swiss HIV Cohort Study reported that the majority of persons living with HIV up to 64 years of age are more likely to identify as current smokers compared with former smokers and never smokers, while HIV-infected persons older than 65 years of age are more likely to identify as never smokers (9). Recent studies have also reported conflicting results on whether ever smokers compared to never smokers are more likely to be male (20) or female (17). The HIV-infected study population that produce these results must be carefully considered, as the HIV-infected population is likely heterogeneous in demographics related to smoking, for example affluent white men who have sex with men (MSM) and lower socioeconomic status women of color.

1.2 Retention in HIV primary care

Immediately linking HIV-positive persons to continuous primary care is one of the key goals of the 2010 US National HIV/AIDS Strategy. There is no gold standard of measuring retention in HIV care, however, similar estimates of retention are found by measuring gaps in care, visit constancy, and Health Resources and Service Administration (HRSA) medical visit criteria (23). Long-term retention in care has been associated with timely reception of antiretroviral therapy, increased virologic control (24-26), and decreased race/ethnicity-related healthcare disparities among African Americans (27). Characteristics of HIV-infected individuals with poor retention in care include younger age, non-White race/ethnicity, greater alcohol and illicit drug use, higher CD4 count, and greater hepatitis C virus coinfection (29-35). Conversely, having a chronic

medical comorbidity, using HAART, and being identified in as having MSM transmission risk were associated with better retention in care (30). Failing to be retained in HIV primary care, particularly in the first year post-HIV diagnosis, has been associated with adverse HIV-related outcomes and increased long-term mortality (28).

1.3 Cigarette smoking and retention in HIV primary care

Although approximately 36% to 50% of HIV-infected individuals are not in routine care (29, 36, 37), little research has been focused on the relationship between cigarette smoking and retention in HIV primary care. Hessol et al. investigated whether cigarette smoking was associated with retention and attendance of women enrolled in the Women's Interagency HIV Study (WIHS) (38). This study investigated demographic factors associated with poor early and later retention including cigarette smoking history. Predictors of retention include older age, White race, higher CD4 cell count, and lower HIV viral load. Cigarette smoking was not found to be a significant predictor of retention. The authors utilized a time-varying approach to capture predictors in retention and the study population was limited to women, the majority of whom were women of color and of lower socioeconomic status.

In general, HIV-infected substance users may be less likely to have an HIV-care provider or to be receiving HAART (39), more likely to use emergency department services (39), and have worse early retention in HIV care (33 & 38). Poor early retention in care is associated with Black race/ethnicity, hepatitis C infection, substance use, younger age, having a primary care provider, geographic location, and a higher viral load (29, 30, 33, 38, & 41). However, studies have conflicting results on whether lower (38) or higher CD4 cell counts (30 & 33) are associated with poor early retention in care. In

addition, studies on retention in care have used undefined terms such as “substance abusers” or “substance users” without specifying whether cigarette smokers are included in this subgroup (33).

Although there are limited studies of cigarette smoking and retention in HIV primary care, recent publications have highlighted a significant relationship between smoking and ART nonadherence (42 & 43). Using self-administered medical questionnaires to assess HAART adherence, Spire et al.’s 2002 study identified several factors associated with poor adherence: younger age, poor housing conditions, lack of social support, and previous history of poor adherence to ART regimens. Furthermore, the authors found non-adherence associated with dynamic characteristics of patients not easily identifiable by clinicians before prescription of ART: depression, symptoms associated with treatment side effects, perception of health status, beliefs toward HAART effectiveness and toxicity, alcohol consumption, and cigarette smoking (44). Patients who increased their smoking consumption from HAART-initiation and those who maintained a heavy consumption of cigarettes were more likely to be non-adherent to HAART at the four month follow-up visit.

Similarly, Shuter & Bernstein conducted an ART adherence study using the Medication Event Monitoring System and found current smoking, but not former smoking, to be a significant factor of poor ART adherence compared to non-smokers (45). This relationship may be explained by multiple drug use, such as cigarette smoking with alcohol abuse or injection drug use (42), or by depression (43).

1.4 Tobacco cessation interventions targeting HIV-infected individuals

Despite the association between cigarette smoking and non-adherence in ART use

in HIV-infected individuals, few smoking cessation programs exist to target this population. We are aware of only two publications reporting findings from smoking cessation trials targeting HIV-infected persons (46-48, 49). These findings suggest that cessation treatments can significantly reduce smoking rates among HIV-infected persons. Although smoking cessation trials targeting HIV-infected persons are lacking, there is a high self-reported desire among HIV-infected smokers to quit smoking, with significant interest and adherence in smoking cessation services and programs (7, 46-48, 50, & 51).

The objective of this thesis is two-fold:

1. to describe patterns of cigarette smoking in HIV-infected adults by demographic characteristics; and
2. to estimate the association of cigarette smoking on failing to be retained in HIV primary care.

Smoking habits can change over time, requiring a time-varying approach to most accurately capture cigarette smoking patterns over time. Using a time-fixed approach to measure cigarette smoking can contribute to imprecise estimated proportions of HIV-infected persons who smoke (7, 20, & 52). Findings of this study could serve to further emphasize smoking cessation efforts in HIV primary care. Smoking cessation after entry into HIV primary care may be particularly important for successful smoking cessation and retention in long-term HIV management.

Chapter 2: Methods

2.1 Study design and population

The NA-ACCORD is a multi-site collaboration of interval and clinical cohort studies of HIV-infected adults (>18 years old) in the United States and Canada. The NA-ACCORD is one of the multi-national cohort collaborations sponsored by the National Institute of Health's International Epidemiological Databases to Evaluate AIDS consortium. Details on the NA-ACCORD collaboration have been published previously (53) and are regularly updated on their dossier (www.naaccord.org). Participants in the NA-ACCORD were enrolled in previously-established contributing clinical and interval cohorts; participants in clinical cohorts were required to have 2 clinical visits within 12 months and ≥ 90 days apart for enrollment. Cohorts contribute data on patient demographics, prescribed ART, dates of primary HIV clinical visits, clinical diagnoses, vital status, and results of laboratory tests (including HIV-1 RNA viral load). All data are transferred securely to the NA-ACCORD's central Data Management Core (DMC, University of Washington), where they undergo quality control per a standardized protocol before they are combined into harmonized data files. Additional quality control measures are enforced on the data at the Epidemiology/Biostatistics Core (Johns Hopkins Bloomberg School of Public Health) prior to the creation of analytic data files. The activities of the NA-ACCORD have been reviewed and approved by the local institutional review boards for each site and at Johns Hopkins School of Medicine.

The NA-ACCORD data collected in calendar year 2011 (i.e. "Protocol 2011" or P2011) current as of October 9th, 2013, were used as the data source. Patients were selected into our nested study according to inclusion criteria outlined below.

2.2 Inclusion criteria

At the cohort level, the analysis was limited to the six contributing NA-ACCORD clinical cohorts that had a median number of ≥ 2 reported smoking statuses for each individual. The six cohorts used were the HIV Research Network (HIVRN), the Johns Hopkins HIV Clinical Cohort (JHHCC), the Ontario HIV Treatment Network Cohort Study (OHTN), the Southern Alberta Clinic Cohort (SAC), the University of Alabama at Birmingham 1917 Clinic Cohort (UAB), and the University Of Washington HIV Cohort (UW). These cohorts have sites in three US Census Bureau-designated regions (Northeast, South, and West) and four Canadian provinces and territories (Alberta, British Columbia, Ontario, and Saskatchewan). From this point forward, the cohorts were assigned numeric labels in efforts to conceal cohort-specific results.

At the individual level, the analysis included only who had laboratory (either CD4 count or HIV-1 viral load) and substance use survey data for at least two visits between January 1, 2008 and December 31, 2010; laboratory data were used to measure the outcome of interest (failure to be retained in care) and substance survey data were used to measure the exposure of interest (smoking status). For Aim 2, patients were also required to be retained in care during the year of their first visit to ensure they were at risk for the outcome of interest. Cohort 3 was excluded from Aim 2 due to lack of HIV primary care data, which is needed to measure the outcome of retention in care.

2.3 Outcome: Failure to be retained in care

The outcome of interest was failing to be retained in care. Participating cohorts provided information on HIV primary care visits; surrogates for retention in HIV care, such as CD4 count or HIV RNA measurements, were not used. Retention in care was

defined using the Institute of Medicine's (IOM) retention in care definition: ≥ 2 HIV primary care visits ≥ 90 days apart in a calendar year (40). Failing to be retained in care was identified as the last date at which an individual was meeting the definition of retained in care (a conservative approach).

2.4 Exposure: Never/ever/current smoking status

Smoking history was collected from cohorts using a substance survey that collected self-reported data. Metadata describing the time frame during which a cohort collected substance survey data were used to determine the smoking status observation periods for each cohort; the smoking status periods for each cohort can be seen in Figure 1.

There was not a standardized substance survey data collection tool across the cohorts, rather, the NA-ACCORD DMC requested any and all smoking data collected by each cohort via any type of substance survey. The DMC reviewed all cohort-specific data collection tools and mapped the smoking data from questions on the substance surveys into the following categories by cohort: current, current none, past, unspecified time frame, never, and not mapped. For this nested study, if the NA-ACCORD substance use response code was classified as "current," the time-varying smoking status for this patient at this time point is "current". If the response code was classified as past/unspecified time frame, the time-varying smoking status for this patient at this time point was classified as "ever". If the response code was classified as never, the time-varying smoking status for this patient at this time point was classified as "never".

Smoking data were then systematically cleaned so that an individual reporting current or ever smoking could not subsequently report never smoking. Duplicate patient

records with the same smoking status noted on the same day were omitted. If there were more than two responses on the same day the priority was given to current smoking status, followed by ever and then never.

2.5 Potential confounders

Factors (measured at baseline) investigated for associations with cigarette smoking (exposure) and retention in care (outcome) include age, sex, race/ethnicity, HIV transmission risk group, geographic region of residence, and previous or current highly active antiretroviral treatment (HAART). A conceptual framework of the relationship between our measured covariates and the smoking and failure to be retained in care relationship of interest in the NA-ACCORD can be found in Figure 2. Potential confounders were evaluated by determining the associations of the confounders and smoking status (exposure) through our analyses for Aim 1, and carefully thinking about the causal relationships of the confounders and retention in care (outcome).

Age was centered on the mean age (45.71 years) and scaled by 10 years to improve interpretability of the coefficient. Race/ethnicity was categorized as non-Hispanic White, non-Hispanic Black, Hispanic, and other/unknown. HIV transmission risk group was dichotomized as IDU versus non-IDU to avoid issues of collinearity between male sex and MSM. For US residences, geographic region was defined by 3-digit zip code of residence. If residence zip code was unavailable, 3-digit zip code for the clinic site was used as a proxy for residence. Geographic region for Canadian residences was defined by self-reported province of residence. Geographic region of residence was included in analyses as a categorical variable, categorized as Southern US, outside Southern US, and Canada.

HAART use was defined as a regimen of at least three antiretroviral agents including a protease inhibitor (PI), non-nucleoside reverse transcriptase inhibitor (NNRTI), fusion inhibitor (FI), or integrase inhibitor (II), or else, a triple nucleoside/nucleotide reverse transcriptase inhibitor (NRTI) regimen containing abacavir (ABC) or tenofovir (TDF) (54). Patients were classified as never-HAART users or ever-HAART users at their baseline visit. CD4 count and HIV-1 RNA viral load were defined using the lab data collected closest to the first visit with reported smoking status, within a window of 12 months prior to one month after the first visit with smoking status. HIV viral load and CD4⁺ T-lymphocyte (CD4) count were used to describe the population but were not used as potential confounders to avoid over-adjustment for HAART use (55).

2.6 Statistical approach

Data were analyzed using StataIC statistical software version 12.1 (StataCorp LP, College Station, TX). A p-value <0.05 guided statistical interpretation.

Missing data

There was a low percentage of missing demographic and clinical covariate data. No individual had missing baseline age, sex, or prior/current HAART use status. Less than 10% of individuals had missing data on HIV risk transmission group (7.34%), HIV-1 RNA viral load at baseline (5.48%), CD4⁺ T-lymphocyte count at baseline (5.48%), race/ethnicity (0.20%) and region of residence (0.14%). Due to the low numbers of missing covariate data, model-wise deletion was used for our analyses, which excluded those with missing characteristics.

To address missing data for smoking status (exposure status), we utilized a carry-forward approach first described in the Nurses' Health Study assessing smoking and

mortality among women with type-2 diabetes (56). For any patient who was previously defined as never or ever smoker and failed to provide an update on smoking status during any visit, their smoking status was carried forward for the remainder of the visits to reduce the proportion with missing data. To address missing data for current smokers, the current smoker status was carried forward to the first visit with missing or not recorded smoking status data. All subsequent missing or not recorded smoking statuses were replaced with the ever smoker status.

Exploratory data analyses

Exploratory data analysis of the relationships between our exposures of interest and baseline smoking status produced significant associations. For Aim 1, a check for collinearity amongst all covariates of interest confirmed correlation was not an issue, with the strongest correlation being between age at baseline visit of and injection drug use ($\rho = 0.1769$).

Statistical Analyses

Pearson's chi-square tests for independence were used to explore the association between baseline smoking status and categorical demographic/HIV covariates (race, sex, geographic region, ever-HAART use, and HIV risk transmission group). Likelihood ratio chi-square tests were used to explore the association between baseline smoking status and continuous demographic/HIV covariates (age, HIV-1 RNA, and CD4⁺ T-lymphocyte count).

Participants were followed from baseline (defined as the first visit with reported smoking status and recorded laboratory data) to the last visit with recorded laboratory data that was < 90 days from the first visit within the calendar year (outcome) or

administratively censored on December 31, 2010. A graphical representation of person-time accrual for four hypothetical patients appears in Figure 3.

For Aim 1, participants were assigned a smoking status for the calendar years of 2008, 2009 and 2010 as the heaviest smoking status reported for that year (current = heaviest). The proportions of participants who were never, ever, and current smokers were estimated as the number of never, ever, and current smokers divided by the number of participants with an observed smoking status in that year, respectively. Trends in the proportions of never/ever/current smokers from 2008 to 2010 were detected using logistic regression models with generalized estimating equations (GEE) using independent correlation matrixes and robust variance estimations to account for the correlation in the data as an individual could contribute to each calendar year from 2008 to 2010.

For Aim 2, the analytic goal was to isolate the effect of smoking on failing to be retained in HIV primary care. In addition to drawing a conceptual framework and determining the associations of the confounders and smoking status (exposure) in Aim 1 and the associations of the confounders and failing to be retained in care (outcome) in univariate models, forward, backward, and hierarchical stepwise selection approaches were considered. Race/ethnicity, age, and IDU HIV transmission risk were included in the model for face validity as the relationships between these confounders and smoking status and retention in care were described in previous literature (4, 7, 9, 17, 20-22, 29-35, 38, 41).

Univariate and multivariate Cox proportional hazard models with the Efron method for ties were used to assess associations between time-varying smoking status and failing to be retained in HIV primary care over the study period. Crude (HR) and

adjusted (aHR) hazard ratios (HR) and 95% confidence intervals ([,]) were reported for each model. The proportionality assumption in the Cox proportional hazard model was verified based on the Schoenfeld and scaled Schoenfeld residuals tests and review of the cumulative hazard plot. Kaplan-Meier survival curves were plotted and log rank tests were performed to evaluate differences in survival by smoking status (Figure 4). A check for collinearity amongst all variables confirmed that none were correlated; the strongest correlation was between smoking and IDU ($\rho = -0.23$). Wilcoxon-Breslow-Gehan tests for equality were performed to assess the equality of the survivor functions, by smoking status.

Sensitivity Analyses

Geographic region of residence was substituted with cohort to determine the existence of an association between cohort and failing to be retained in HIV primary care. Univariate and multivariate Cox proportional hazard models with the Efron method for ties were used to assess the crude and adjusted associations between cohort and retention in care. Crude (HR) and adjusted (aHR) hazard ratios (HR) and 95% confidence intervals ([,]) were reported for each model.

Chapter 3. Results

3.1 Population characteristics

A total of 3,575 HIV-infected participants met the inclusion criteria of whom 74% were male, 47% were African American, 19% were IDUs, 62% resided in the Southern region of the U.S., and the mean (SD) age was 45.7 (9.7) years (Table 1). Of the total participants, 28% were current smokers at baseline who contributed 615.17 person-years, 43% were ever smokers who contributed 776.57 person-years, and 28% were never smokers who contributed 631.56 person-years.

More than half (53%) of the current smokers were African Americans but White participants were the majority among ever smokers (Table 1). The majority of patients were classified into the non-injection drug use HIV transmission group (81%). Patients in the non-IDU transmission group were more likely to be ever smoking at the baseline visit (43%), and injection drug users (IDU) were more likely to be ever (44%) or currently (44%) smoking at the baseline visit. Log(10)-transformed HIV-1 RNA viral load significantly differed among smoking status groups at baseline, while adjusting for HAART use. Viral loads were statically significantly higher among ever and current smokers compared with never smokers among HAART users ($p=0.0489$) and never-HAART users ($p=0.0387$). Median year of HAART initiation did not significantly differ among smoking status groups. Median CD4⁺ T-lymphocyte count was statistically significantly higher among never smokers compared with ever and current smokers (483, 463, and 445 cells/mm³, $p=0.0425$).

3.2 Patterns of cigarette smoking, Aim 1

Participants reporting current smoking status fluctuated from 31-33% in 2008,

2009 and 2010 (p for trend <0.001 , Figure 5). The proportion reporting never smoking status decreased from 31% in 2008 to 25% in 2009 and 26% in 2010 (p for trend <0.001). The proportion reporting ever smoking increased from 36% in 2008 to 44% in 2009 and 42% in 2010 (p for trend <0.001). The changes over time in the proportions of current, ever, and never smokers are relatively small (<10 percentage points) and may be influenced by the observation periods of each cohort (Figure 6). For example, cohorts 1 and 4 do not contribute in 2008, and cohort 6 does not contribute in 2010; all three of these cohorts have a small proportion of never smokers and a large proportion of ever smokers. It is also important to note that the cohorts report large differences in the proportions who are current, ever and never smokers; this is not surprising as these cohorts differ in demographic characteristics that have been linked to smoking prevalence (4, 7, 9, 17, 20-22). The observation periods for each cohort coupled with the differences in the smoking prevalence's across cohorts are driving the small fluctuations in the overall proportions of current, ever, and never smokers.

Regardless of age, patients were less likely to report never smoking over time and more likely to report ever smoker over time (Figure 7). Patients 40 to 49 years of age had the largest proportions of current smokers in all three years from 36% in 2008 to 33% in 2009 and 36% in 2010 (p for trend $=0.041$). Patients 60 years of age or older had the largest proportions of never smokers in all three years from 43% in 2008 to 35% in 2009 and 35% in 2010 (p for trend <0.001).

Female patients had a greater proportion of never smokers over time but also a greater proportion of current smokers compared to males across the study period ($p <0.001$) (Figure 8).

White, Black, and Hispanic patients were more likely to report ever smoking across the study period and less likely to report never smoking across the study period (Figure 9). White and Black patients were also less likely to report current smoking over time (p for trend=0.002 & 0.004, respectively). Black patients reported the largest proportion of never smokers in 2009 and 2010 with 30% and 31%, but also reported the largest proportion of current smokers across the study period, with 37% in 2008 to 36% in 2009 and 34% in 2010. Patients with other or unknown race were less likely to report ever smoking over time (p for trend =0.011). Patients with other or unknown race reported the largest proportion of ever smoking in 2008 and 2009 with 65% and 57%, respectively.

Patients in the non-IDU transmission group were more likely to report never or ever smoking across the study period compared to patients in the IDU transmission group ($p < 0.001$) (Figure 10). Almost 50% of patients in the IDU transmission group reported currently smoking across the study period compared to 26-29% in the non-IDU transmission group.

Patients residing in the Southern US had the largest proportions of current smokers across the study period (33-36%) compared to other regions (13-30%), however this proportion decreased over time (p for trend < 0.001) (Figure 11). Canadian residents and US residents outside of the South had larger proportions of ever smokers across the study period (42-81%) compared with patients from the US South (29-41%). The proportion of US patients reporting never smoking decreased over time, (p for trend =0.001 for Outside US South & < 0.001 for US South), while the proportion reporting ever smoking increased over time (p for trend =0.037 & < 0.001 , respectively). There

was an increasing trend in reporting currently smoking for Canadian patients across the study period (p for trend =0.021) and a decreasing trend in reporting ever smoking over time (p for trend =0.015).

There were no differences in cigarette smoking by HAART use at baseline visit over the study period.

3.3 Association between cigarette smoking and failing to be retained in HIV primary care, Aim 2

A total of 2,571 patients contributed 4,072.988 person-years while under observation; approximately 37% ($n=948$) of patients were seen in all three years (2008, 2009, 2010) of the study period. A total of 444 failures to be retained in care (outcome) were observed; 153, 149, and 142, among current, ever, and never smokers, respectively. Among all participants, 23 (0.89%) died.

The Kaplan-Meier survival estimates and the Wilcoxon-Breslow-Gehan tests for survival function equality, by smoking status can be seen in Figure 4. There was a greater number of events observed than expected among never and current smokers and a lesser number of observed events than expected among ever smokers. Never, ever, and current smokers have differing probabilities of retention in care over the study period (p =0.0168). Patients identified as never, ever, and current smokers followed a similar trend in failure across calendar time (Figure 12). Regardless of smoking status, patients had an increasing probability of failing to be retained in care in the first and fourth quarters of 2009 and 2010 (Jan-Mar & Oct-Dec). Probability of failing to be retained in care decreased in the second and third quarters of 2009 and 2010 (Apr-Sept). The Schoenfeld and scaled Schoenfeld residual test failed to find a violation of the proportional hazards

assumption in our multivariate models ($p = 0.4225$).

In crude (univariate) models, ever smokers had a 27% decrease in the risk of failing to be retained in care compared to never smokers ($HR = 0.73$ [0.58, 0.92]), but there was no relationship between current vs. never smokers on failing to be retained in care. Blacks (compared with Whites $HR = 1.66$ [1.36, 2.02]) IDUs (compared with non-IDU $HR = 1.71$ [1.37, 2.15]), and Southern US residents (compared with outside the Southern US $HR = 3.78$ [2.21, 6.46]) all had statistically significant increases in the risk of failing to be retained in care; Canadians had a reduced risk of failing to be retained in care compared to those residing in the US outside of the South ($HR = 0.48$ [0.23, 1.00]). Age (scaled by 10 years and centered on sample average age) had a statistically significant decrease in the risk of failing to be retained in care; ($HR = 0.90$ [0.82, 0.99]). There was no crude association of sex or HAART use and failing to be retained in care.

In multivariate models that adjusted for age, race/ethnicity, IDU status, geographic region of residence, HAART use, the statistically significant decrease in the risk of failing to be retained in care among ever compared with never smokers remained ($aHR = 0.64$ [0.50, 0.81]); the lack of an association between current smokers (vs. never) and failing to be retained in care persisted ($aHR = 0.92$ [0.73, 1.17]). Age (scaled by 10 years and centered on sample average age) (vs. average age $aHR = 0.83$ [0.75, 0.92]), IDU (vs. non-IDU $aHR = 1.36$ [1.06, 1.74]), and geographic region (US South vs. outside US South $aHR = 2.10$ [1.19, 3.69]; Canada vs. outside US South $aHR = 0.32$ [0.15, 0.68]) relationships with failing to be retained in care persisted (Table 2). There were no statistically significant or meaningful differences between sex, race/ethnicity or HAART use and failing to be retained in care in the multivariate models (Figure 13).

In a sensitivity analysis of the crude (univariate) model for retention in care by cohort, patients in Cohort 2 and Cohort 6 (vs. Cohort 1) had statistically significant increases in the risk of failing to be retained in care (HR=10.15 [2.52, 40.80] & HR=5.80 [1.27, 26.52]). In the multivariate model, substituting cohort for geographic region of residence, the decrease in the risk of failing to be retained in care among ever compared with never smokers was no longer statistically significant (aHR=0.96 [0.74, 1.25]; the lack of an association between current smokers (vs. never) and failing to be retained in care persisted (aHR=0.99 [0.78, 1.26]) (Table 3). The statistically significant decrease in risk of failing to be retained in care by age persisted (aHR=0.79 [0.71, 0.87]). The cohort relationship with failing to be retained in care persisted (Cohort 2 vs. Cohort 1 aHR=11.49 [2.78, 47.53]; Cohort 6 vs. Cohort 1 aHR=5.79 [1.24, 26.92]). There were no statistically significant or meaningful differences between sex, race/ethnicity, IDUs, or HAART use and failing to be retained in care in the sensitivity analysis of the multivariate models (Figure 14).

Chapter 4: Discussion and Conclusion

4.1 Discussion

In a large, clinical cohort collaboration of HIV-infected persons from the NA-ACCORD, 70-75% of adults reported current or ever smoking, as compared to the general population in the United States and Canada where smoking prevalence is estimated to be 19.3 % and 16.7%, respectively (57 & 58). Among HIV-infected adults, annual prevalence of current and ever smokers differed by age, race/ethnicity, sex, IDU status, and region from 2008-2010. Ever smokers had a decrease in the risk of failing to be retained in care compared to never smokers, after adjusting for demographics and HAART use. Current smokers had an increased risk of failing to be retained in care compared to ever smokers, after adjusting for demographics and HAART use.

Patterns in smoking among HIV-infected adults, 2008-2010

There were interesting patterns of smoking by age, sex, race/ethnicity, IDU status and geography. Middle-aged patients (40-49 and 50-59 year olds) reported the highest proportions of current smokers. As expected, older patients (60+ year olds) reported the highest proportion of never smokers; this is likely a survival bias. Studies in the general population and in HIV-infected adults show that age is a strong predictor of smoking status (7 & 20). Because people with HIV are living longer (59) and are thought to be at higher risk for age-related comorbidities (2, 4, 12-14) that are also influenced by smoking, smoking cessation programs are urgently needed and should be targeted to middle and younger ages.

Women had slightly higher proportions who were never smokers compared to men in all three years examined, however, they also had greater proportions who were

current smokers. This may reflect that the age distribution among women is concentrated in the middle-ages where current smoking prevalence is highest. Similar to patterns seen in women, Black adults had higher proportions of current and never smoking in all three years compared to White adults; these results are likely reflecting that the age distribution among Black adults is concentrated in the middle-ages where current smoking prevalence is highest. As expected, IDUs had highest proportions of current smokers in all three years, ranging from 46-51%. Finally, the US South had the highest proportion of current smokers, but also the highest proportion of never smokers; these results are likely reflecting that the age distribution among Southern US adults is concentrated in the middle-ages where current smoking prevalence is highest. These patterns demonstrate the need for targeted smoking cessation interventions among middle-aged, female, Black, IDU adults and those that reside in the Southern US. Further studies looking at the smoking prevalence in combined demographic categories, like Black women residing in the Southern US, are needed.

The association of smoking status on retention in care

At first, the findings seem counter-intuitive: why would ever smoking (vs. never smoking) reduce the risk of failing to be retained in care? Prior research suggests that HIV-infected individuals who do not smoke have less HIV-associated and non-HIV associated infections than those with smoking history (4, 7, 9, 17, 20-22), signaling that those who do not smoke are healthier than current smokers. Additionally, it has been shown that having a chronic medical comorbidity is associated with improved retention in HIV care (30). HIV-infected adults who were ever smokers may require a greater number of clinic visits due to their increase risk of chronic conditions and have greater

retention in care due to the need to treat their chronic conditions.

Our findings did not show an association between never smoking and current smoking and failing to be retained in care. Although we expected to see an increase in the risk of failing to be retained in care among current compared with never smokers, it may be that there is a “healthy current smoker” effect. Smokers that have negative health effects from smoking may be more likely to quit, but current smokers may be more likely to continue smoking without immediately identified negative health effects. Those that reported currently smoking may be healthier than ever smokers, may tend to smoke with less frequency, and may have shorter smoking history compared to ever smokers; resulting in less encouragement from their medical providers to quit or reduce their smoking consumption. Further, if smokers feel similar in health to never smokers, their retention in care may be similar, resulting in no difference in the risk of failing to be retained in care comparing current with never smokers, as our results show. This time-dependent confounding of perceived health status on the relationship of smoking on failing to be retained in care was not taken into account in our analyses as the NA-ACCORD participants do not have a measure of perceived health status.

We are limited to speculation on the effects of smoking duration, and smoking frequency on retention in care in our sample, due to a lack of comprehensive quantitative data on smoking history. Future research may focus on assessing the relationship between retention in HIV primary care and quantitative data on smoking consumption, such as pack-years.

The association of covariates on retention in care

Although our research question focused on the relationship of smoking and

retention in HIV care, multivariate analyses showed interesting relationships of identified confounders with retention in HIV care. In our study, the unadjusted risk of failing to be retained in care was higher for Black (vs. White) and IDU (vs. non-IDU) participants, and for those living in the Southern US (vs. outside the Southern US). The racial differences did not persist in adjusted models, but the increased risk of failing to be retained in care among IDUs and those living in the southern US remained. The risk of failing to be retained in care decreased with increasing age and was lower among Canadians compared to those residing in the Southern US in crude and adjusted models.

The association between IDU and poor retention has been previously demonstrated, as has the decreased likelihood of failing to be retained in HIV care with increasing age (29-35, 38, 41).

The crude relationship showing an increased risk of failing to be retained in care among Black, compared with White, participants diminishes to a null relationship in the adjusted model, likely due to the inclusion of geographic region of residence in the adjusted model. Previous studies have also demonstrated the increased risk of failing to be retained in HIV care among Black adults, however, these studies did not adjust for geographic region (29-31, 34). The disappearance of race/ethnicity as a significant factor in failing to be retained in care once we adjusted for region of residence suggests that disparities in retention by race/ethnicity are possibly due to a geographic effect.

Geographic region of residence had the strongest association of failing to be retained in HIV care in our crude and adjusted models. Geographic region of residence may serve as a proxy for a number of regional differences related to the acceptance of HIV status and openness to initiating and maintaining routine HIV primary care. HIV-

infected individuals have been found to be less likely to maintain routine HIV care when they disclose their HIV status to less social network members (60) and when they are in need of stable housing (61). Regional differences may exist in the stigma of being HIV-positive, safe sexual practices, average socioeconomic status (SES) and percentage of individuals with employment-provided health insurance, access to public transportation, average car usage, urban sprawl and geographic dispersion of neighborhoods, and varying office hours or scheduling practices by clinics.

In our sensitivity analyses, we substituted cohort for geographic region of residence in the crude and adjusted models. Cohort had the strongest association of failing to be retained in HIV care in our crude and adjusted models, supporting the geographic effect of disparities in retention. After adjusting for cohort, we failed to find previous differences in risks of failing to be retained in care by smoking and IDU in our adjusted model. The decreased risk of failing to be retained in care with increasing age remained in our adjusted model, controlling for cohort.

Finally, there was no difference in the risk of failing to be retained in care by sex or HAART use. Sex has not previously been shown to be a strong predictor of retention in HIV care (30, 35, & 41). Previous studies have demonstrated those who are using HAART are more likely to be retained in care (30). It is possible that this relationship was not demonstrated in our data because 69% of participants were using HAART at baseline of our study. This high proportion using HAART is reflective of HIV-infected adults in clinical care in the US.

4.2 Limitations

Our main limitation was our inability to determine current from ever smokers.

Some ever smokers may be current smokers, however, some of the smoking status data were collected in such a way that only ever/never smoking status was obtained. It is likely that some of the current smokers are classified as ever smokers. Correcting this misclassification may result in an increased risk of failure to be retained in care in current smokers and an even stronger protective effect of ever smoking. There was also limited data regarding the quantity and duration of smoking, such as pack-years.

There may be differences in acceptability of smoking by region. Smokers who live in regions with more limitations on smoking in public spaces or less access to cigarettes in convenience stores may be more likely to underestimate their smoking history or may be more likely to oscillate between currently smoking and attempting to quit due to increased social stigma. These oscillations may not have been accurately captured by our carry forward and carry backward approaches to address missing smoking data.

Additionally, we were unable to account for duration of time since HIV diagnosis, as these data are unavailable in the NA-ACCORD. Failing to be retained in HIV primary care during the first year following an HIV diagnosis is associated with adverse HIV-related outcomes and increased long-term mortality (28). Patients identifying as current smokers within their first year following an HIV diagnosis may be particularly at risk for failing to be retained in care. Identifying these individuals and linking them with routing HIV care and smoking cessation programs may play a critical role in decreasing HIV-related comorbidities and long-term mortality.

Finally, the NA-ACCORD has been shown to be reflective of persons living with HIV in the U.S. (62), however, our study is nested in a sub-sample of 5 NA-ACCORD

clinical cohorts that contributed smoking and HIV primary care visit data; generalizability of our findings may be questionable. Our study population (Table 1) has similar demographic characteristics to people living with HIV/AIDS in the US as of 2011 (64).

4.3 Future Analyses

Future analyses of the effect of smoking on retention in care should take into account:

- The time-dependent confounding of preceded health status on smoking and retention in HIV clinical care using marginal structural models
- The confounding effects of additional social factors on the smoking and retention in HIV care relationship using proportional hazards mixed effects models to adjusting for regional characteristics of HIV stigma, availability of public transportation, urban sprawl, clinic operating practices, median household income of the census block of residence, and patterns of safe sexual practices.

Regional differences in the proportion of convenience stores that sell cigarettes and the percentage of public spaces that are “smoke-free” could also be assessed. Mixed effects models appropriately account for clustered survival times of individuals within the same region and would be able to assess whether a larger proportion of the variance in retention duration is found between regions rather than within regions. Furthermore, mixed effects models can provide more specific recommendations on the level of government to be responsible for targeting smoking cessation services to HIV-infected individuals. If there is a larger discrepancy in retention duration between regions rather than within regions, then channeling national funds to increase tobacco cessation services

for HIV-infected individuals across the country would be more efficient at reducing the hazard of failing to be retained in care among smokers.

4.4 Conclusion

Our findings of the patterns in smoking in HIV-infected adults and the relationship between smoking and retention in HIV care are an important first step in generating ideas for policies and programs to reduce smoking prevalence and increase retention in HIV clinical care in the U.S. and Canada. Programs incorporating smoking cessation into HIV clinical care may help better retain current smokers who are trying to quit. With a prevalence approximately 30% current smokers in this HIV-infected population with access to HIV clinical care, increasing funding of highly accessible and effective smoking cessation programs may result in better health outcomes and progress toward long-term retention in care.

Table 1. Characteristic^a comparisons of 3,575 HIV-infected persons, stratified by smoking status^b, 2008-2010.

		Total		Current Smokers		Ever Smokers		Never Smokers		<i>p</i> ^c
		N =	3,575	N =	1,013	N =	1,554	N =	1,008	
Person-Years, %		2023.3		615.17 30%		776.57 38%		631.56 31%		
Age (years), mean (+/- SD)		45.71 (9.69)		45.98 (8.78)		45.70 (9.71)		44.95 (10.41)		0.6261
Sex	Female	923	26%	289	29%	307	20%	327	32%	<0.001
	Male	2652	74%	724	71%	1,247	80%	681	68%	
Race/Ethnicity										<0.001
	White	1,583	44%	404	40%	813	52%	366	36%	
	Black	1,677	47%	536	53%	579	37%	562	56%	
	Hispanic	102	3%	22	2%	49	3%	31	3%	
	Other/Unknown	213	6%	51	5%	113	7%	49	5%	
HIV Transmission Group ^d										<0.001
	Non-IDU	2895	81%	713	70%	1257	81%	925	92%	
	IDU	680	19%	300	30%	297	19%	83	8%	
Geographic Region ^e										<0.001
United States	Northeast	11	0%	3	0%	2	0%	6	1%	
	South	2220	62%	694	69%	832	54%	694	69%	
	West	443	12%	65	6%	321	21%	57	6%	
Canada	Alberta	493	14%	189	19%	81	5%	223	22%	
	British Columbia	3	0%	2	0%	-	0%	1	0%	
	Ontario	395	11%	59	6%	310	20%	26	3%	
	Quebec	3	0%	-	0%	3	0%	-	0%	
	Saskatchewan	2	0%	1	0%	-	0%	1	0%	
	Missing	5	0%	-	0%	5	0%	-	0%	
Year of HAART Initiation, median (IQR)		2005 (2001, 2008)		2005 (2001, 2008)		2005 (2001, 2008)		2004 (2001, 2008)		0.816
HIV-1 RNA ^f , median (IQR)	Ever-HAART Users	3.91 (3.91, 4.69)		3.91 (3.91, 4.71)		3.91 (3.91, 4.88)		3.91 (3.91, 4.32)		0.0489
	Never-HAART Users	4.32 (3.91, 8.87)		4.62 (3.91, 9.10)		5.38 (3.91, 9.25)		4.17 (3.91, 8.25)		0.0387
	Missing	196	5%	77	8%	65	4%	54	5%	
CD4 ⁺ T-Lymphocyte Count, median cells/mm ³ (IQR)		463 (302, 658)		445 (262, 658)		463 (301, 658)		483 (330, 650)		0.0425
		196	5%	77	8%	65	4%	54	5%	

SD Standard deviation

HAART Highly active antiretroviral therapy

IQR Interquartile range

MSM Men who have sex with men

IDU Injection drug users

^aCharacteristics measured at baseline, defined as first visit with reported smoking status and lab data.

^bSmoking status defined as never if no prior history of smoking, ever if prior history of smoking but not currently smoking, current if currently smoking at baseline.

^cFor categorical variables, p-values are for Pearson's chi-square tests for independence, significance at p<0.05. For continuous variables, p-values are for likelihood ratio chi-square tests, significance at p<0.05.

^dIf a person reported both MSM and IDU, person was classified as IDU.

^eRegion was defined by 3-digit zip code of residence and categorized by Census Bureau-designated regions. If residence zip code was unavailable, 3-digit zip code for clinic was used as a proxy for residence.

^fHIV-1 RNA was log(10)-transformed.

Table 2. Univariate and multivariate analyses of characteristics^a and time-varying smoking status predictive of failing to be retained in HIV primary care^b.

		Crude Hazard Ratio ^c	95% CI	Adjusted Hazard Ratio ^d	95% CI
Smoking ^e	Never	Referent		Referent	
	Ever	0.73	(0.58, 0.92)	0.64	(0.50, 0.81)
	Current	1.08	(0.86, 1.36)	0.92	(0.73, 1.17)
Age (years) ^f		0.90	(0.82, 0.99)	0.83	(0.75, 0.92)
Sex	Male	Referent		Referent	
	Female	1.19	(0.97, 1.46)	0.98	(0.80, 1.21)
Race/Ethnicity	White	Referent		Referent	
	Black	1.66	(1.36, 2.02)	1.00	(0.81, 1.25)
	Hispanic	0.78	(0.40, 1.54)	0.94	(0.47, 1.87)
	Other/Unknown	0.48	(0.21, 1.08)	0.92	(0.40, 2.10)
HIV Transmission Group ^g	Non-IDU	Referent		Referent	
	IDU	1.71	(1.37, 2.15)	1.36	(1.06, 1.74)
Geographic Region ^h	Outside of Southern US	Referent		Referent	
	Southern US	3.78	(2.21, 6.46)	2.10	(1.19, 3.69)
	Canada	0.48	(0.23, 1.00)	0.32	(0.15, 0.68)
HAART Use	Never-HAART Users	Referent		Referent	
	Ever-HAART Users	0.86	(0.69, 1.08)	0.93	(0.74, 1.16)

HAART Highly active antiretroviral therapy

IDU Injection drug users

CI Confidence Interval

^aCharacteristics, apart from smoking, were measured at baseline, defined as first visit with reported smoking status and lab data.

^bFailing to be retained was defined as time to first occurrence when the Institute of Medicine retention in care measure was not met.

^cCrude hazard ratios are for univariate Cox proportional hazard models.

^dAdjusted hazard ratios are for multivariate Cox proportional hazard models adjusted for all variables in the table and cohort.

^eSmoking was time-varying across the study period.

^fAge was centered at the sample mean age (45.71 years) and scaled by 10 years

^gHIV risk was dichotomized as IDU vs. non-IDU to avoid issues of collinearity between male sex and MSM.

^hGeographic region was categorized as US South, non-US South, and Canada due to the majority of the sample residing in US South (62.10%).

Table 3. Univariate and multivariate analyses of characteristics^a and time-varying smoking status predictive of failing to be retained in HIV primary care^b (sensitivity analysis).

		Crude Hazard Ratio ^c	95% CI	Adjusted Hazard Ratio ^d	95% CI
Smoking ^e	Never	Referent		Referent	
	Ever	0.73	(0.58, 0.92)	0.96	(0.74, 1.25)
	Current	1.08	(0.86, 1.36)	0.99	(0.78, 1.26)
Age (years) ^f		0.90	(0.82, 0.99)	0.79	(0.71, 0.87)
Sex	Male	Referent		Referent	
	Female	1.19	(0.97, 1.46)	0.89	(0.72, 1.10)
Race/Ethnicity	White	Referent		Referent	
	Black	1.66	(1.36, 2.02)	0.87	(0.70, 1.09)
	Hispanic	0.78	(0.40, 1.54)	0.89	(0.44, 1.77)
	Other/Unknown	0.48	(0.21, 1.08)	0.81	(0.35, 1.87)
HIV Transmission Group ^g	Non-IDU	Referent		Referent	
	IDU	1.71	(1.37, 2.15)	1.00	(0.78, 1.29)
Cohort ^h	Cohort 1	Referent		Referent	
	Cohort 2	10.15	(2.52, 40.80)	11.49	(2.78, 47.53)
	Cohort 4	1.17	(0.27, 5.11)	1.16	(0.26, 5.22)
	Cohort 5	3.99	(0.98, 16.20)	3.96	(0.95, 16.44)
	Cohort 6	5.80	(1.27, 26.52)	5.79	(1.24, 26.92)
HAART Use	Never-HAART Users	Referent		Referent	
	Ever-HAART Users	0.86	(0.69, 1.08)	1.03	(0.82, 1.28)

HAART Highly active antiretroviral therapy

IDU Injection drug users

CI Confidence Interval

^aCharacteristics, apart from smoking, were measured at baseline, defined as first visit with reported smoking status and lab data.

^bFailing to be retained was defined as time to first occurrence when the Institute of Medicine retention in care measure was not met.

^cCrude hazard ratios are for univariate Cox proportional hazard models.

^dAdjusted hazard ratios are for multivariate Cox proportional hazard models adjusted for all variables in the table and cohort.

^eSmoking was time-varying across the study period.

^fAge was centered at the sample mean age (45.71 years) and scaled by 10 years

^gHIV risk was dichotomized as IDU vs. non-IDU to avoid issues of collinearity between male sex and MSM.

^hCohort 3 failed to provide HIV primary care data and was excluded from analyses.

Figure 1. Time span of data collection on smoking variable, by clinical cohort.

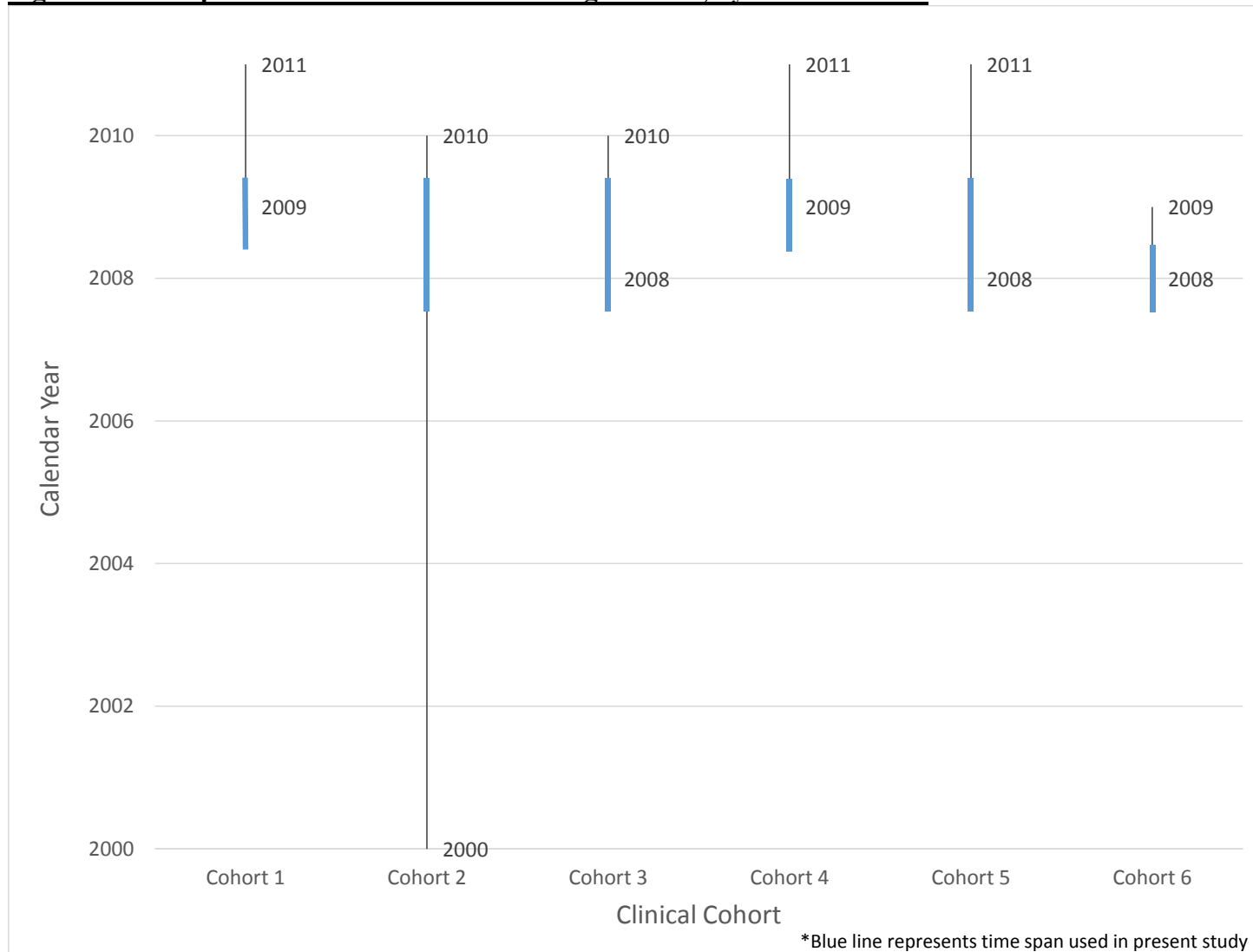


Figure 2. Conceptual framework of measurable variables in the NA-ACCORD.

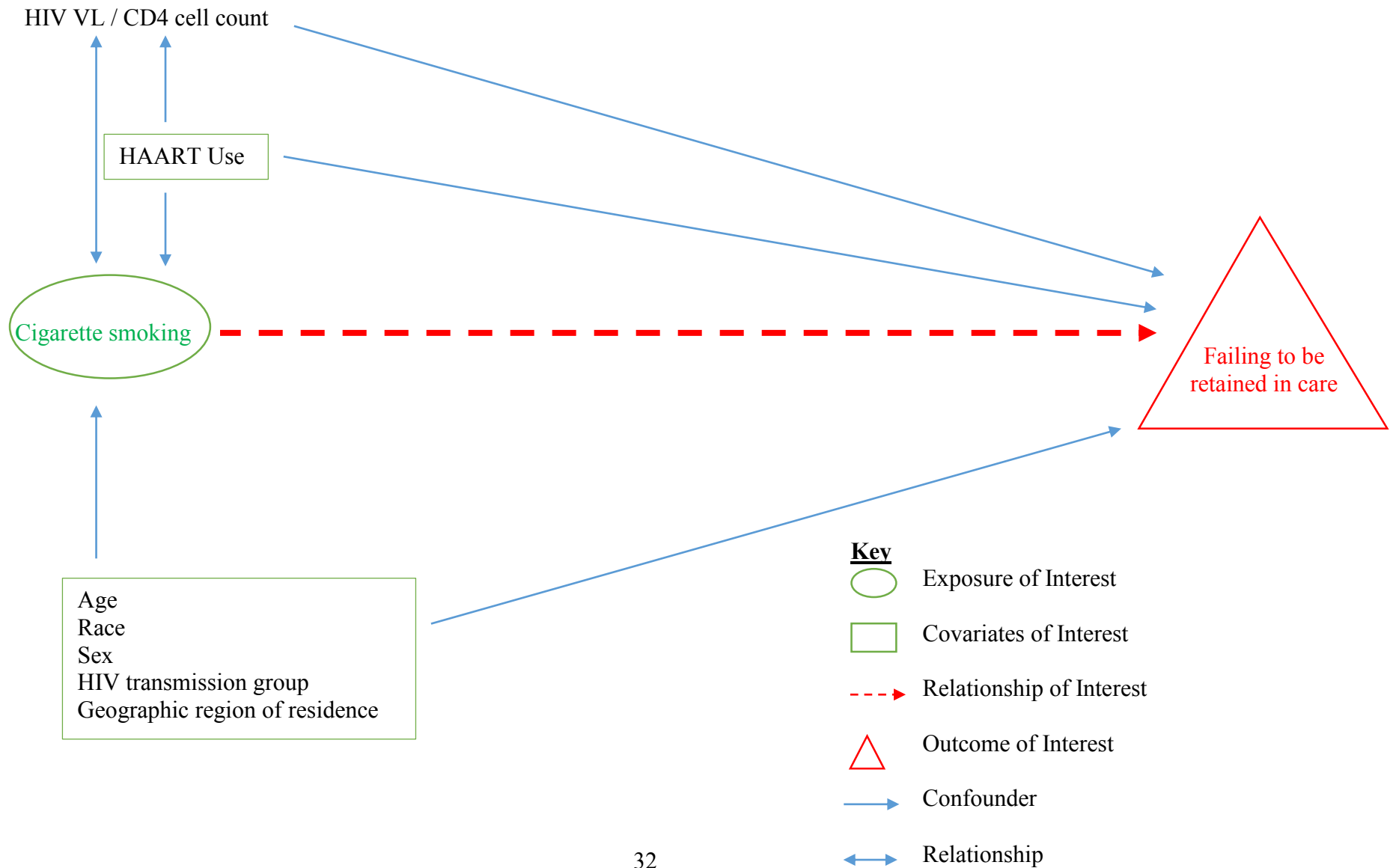


Figure 3. Example of person-time accrual.

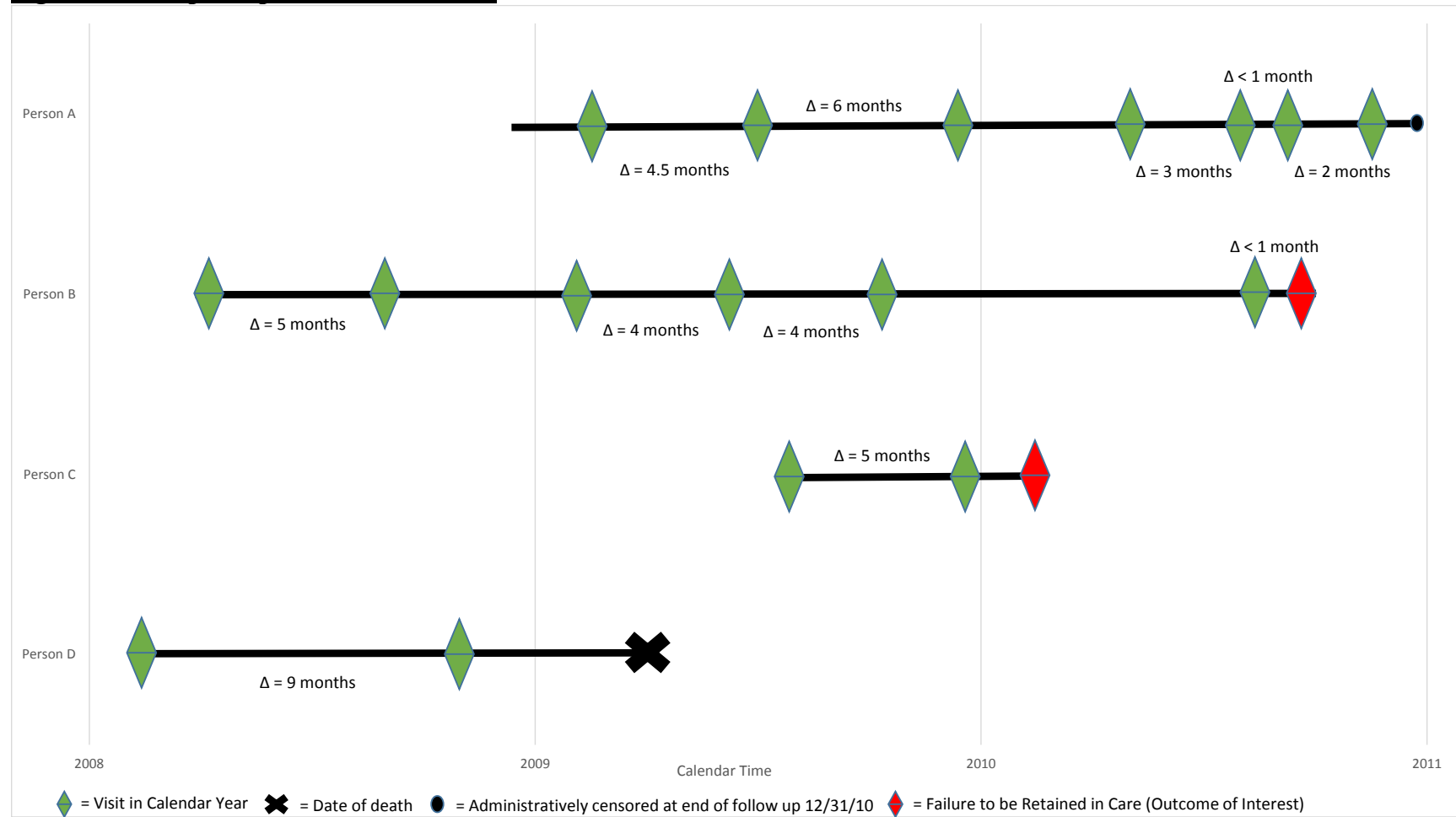
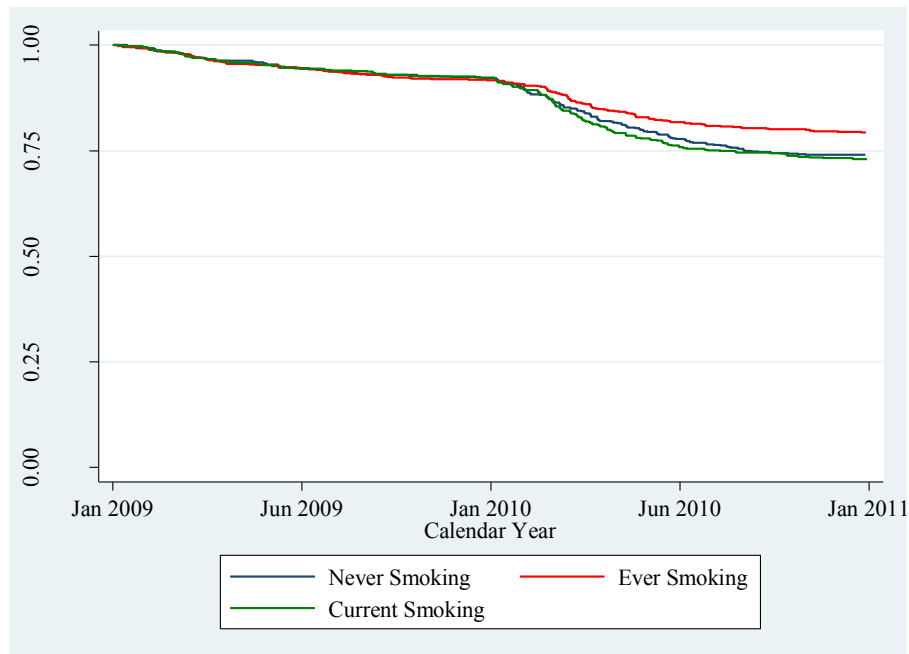


Figure 4. Kaplan-Meier survival estimates (S(t)) of being retained in HIV primary care, by smoking status (2008-2010).



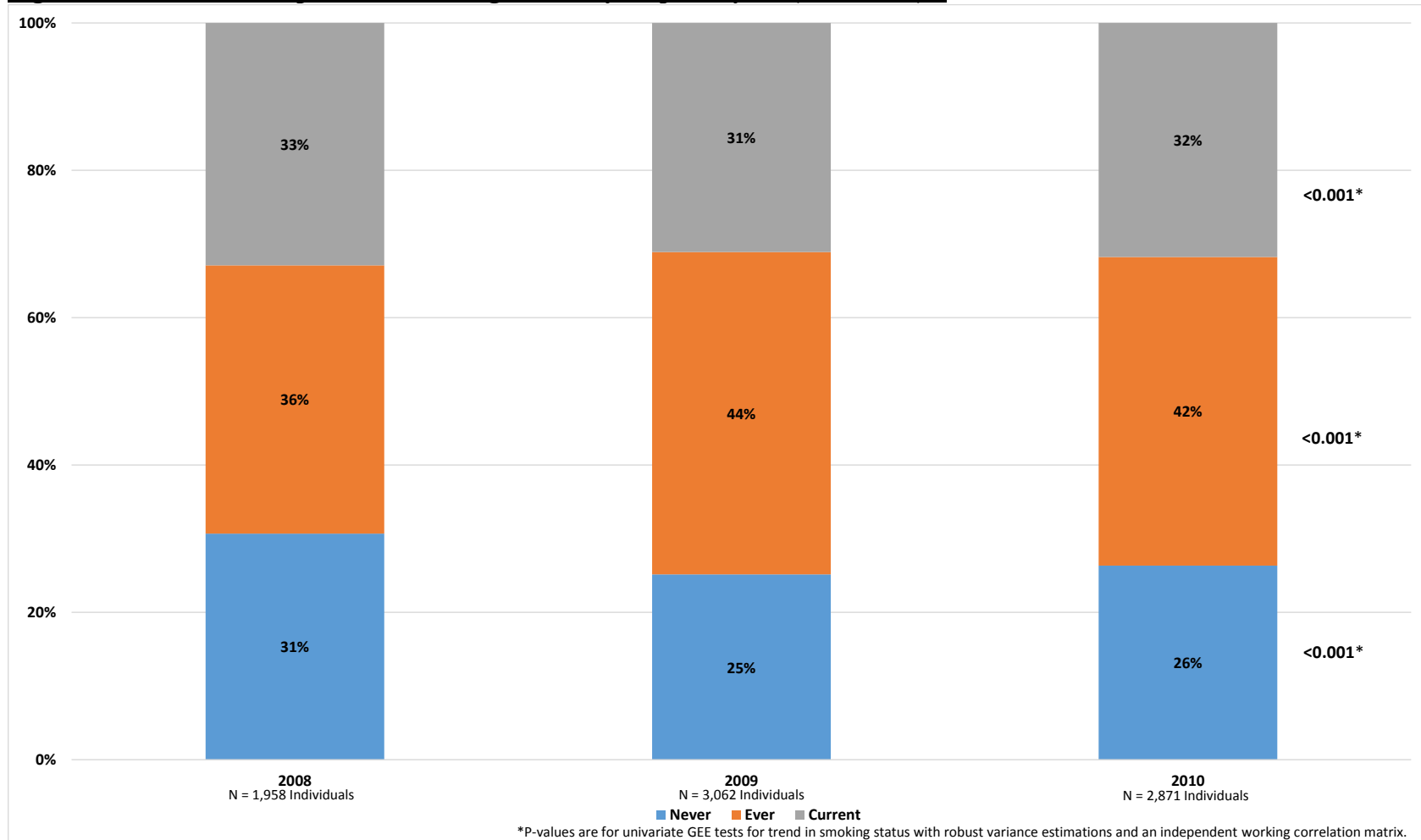
Wilcoxon (Breslow) test for equality of survivor functions, by smoking status

	Events Observed	Events Expected	Sum of ranks
Never Smoking	142	130.5	18327
Ever Smoking	149	178.52	-47497
Current Smoking	153	134.97	29170
Total	444	444	0

Chi-squared(2): 8.18

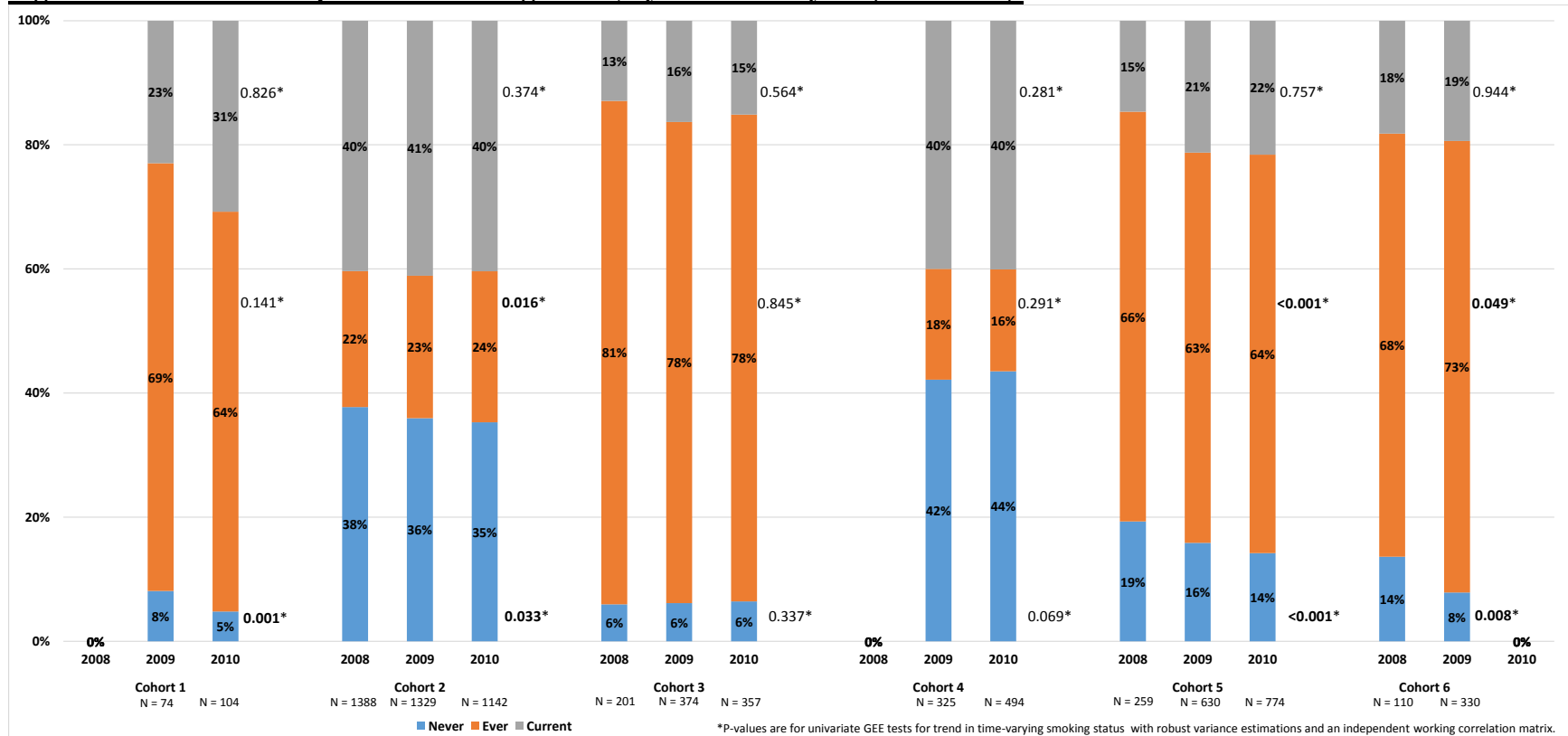
Pr>chi2: 0.0168

Figure 5. Distribution of patients' smoking status, by response year (2008-2010).*



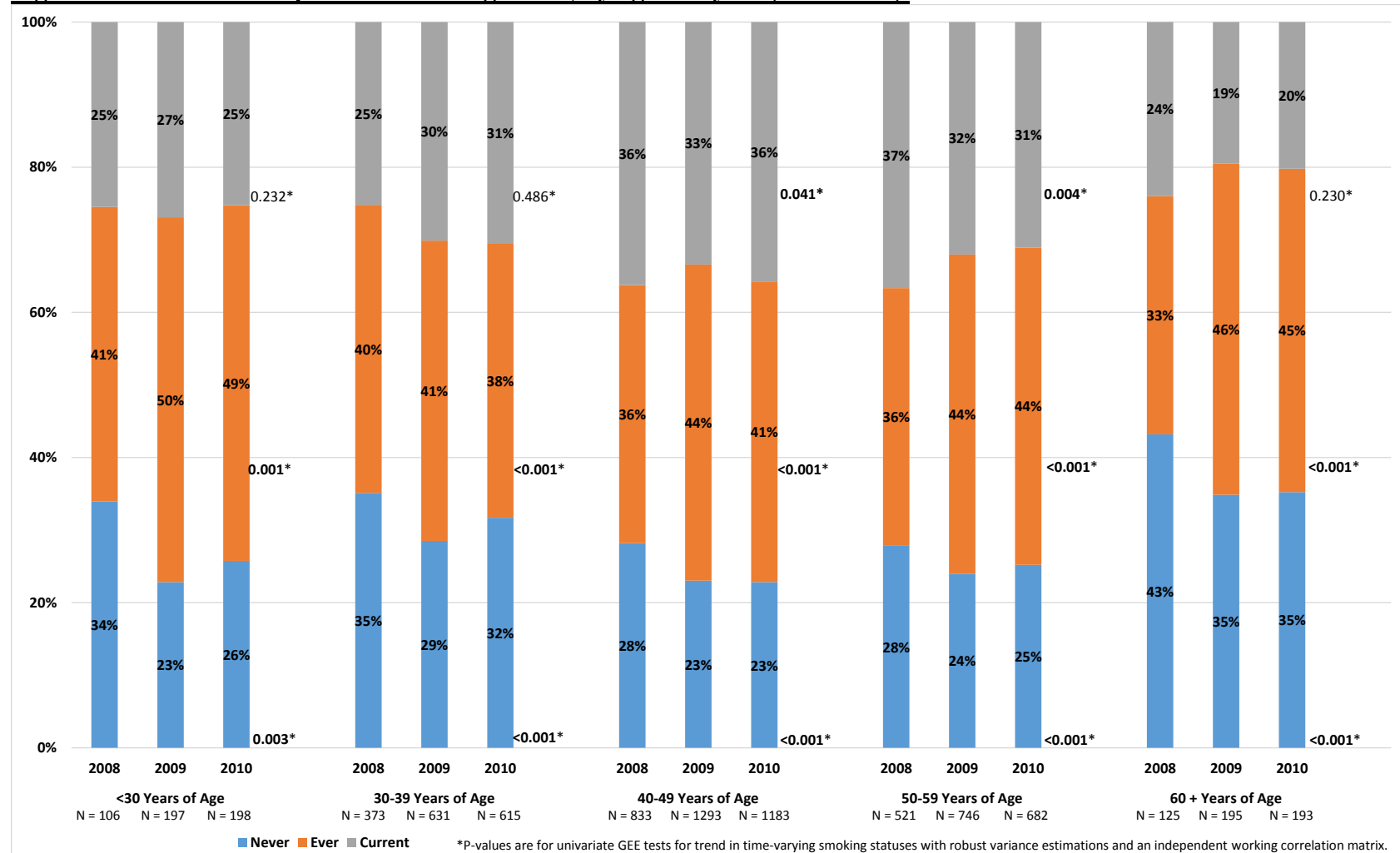
* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Figure 6. Distribution of patients' smoking status, by cohort and year (2008-2010).



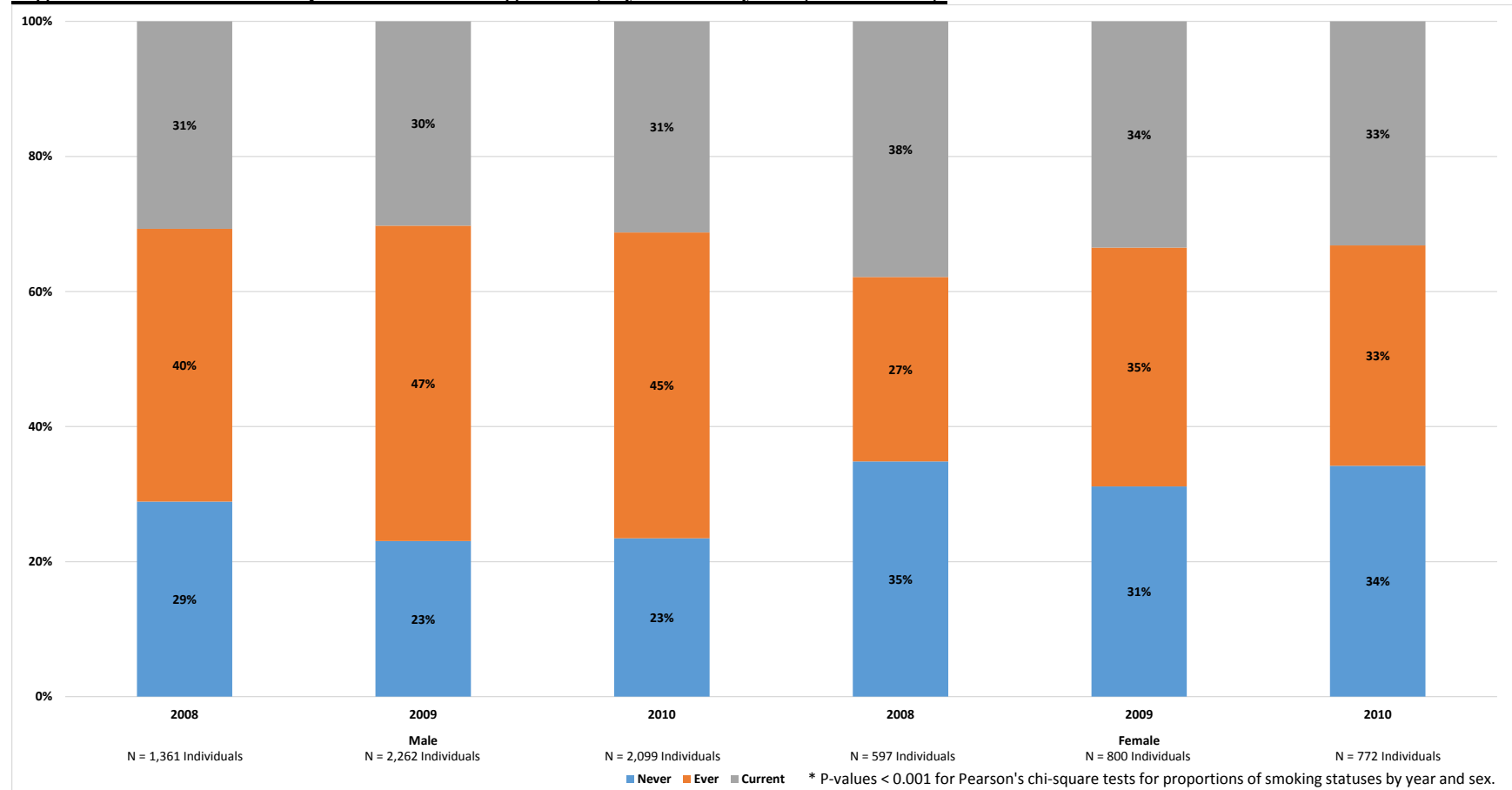
* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Figure 7. Distribution of patients' smoking status, by age and year (2008-2010).



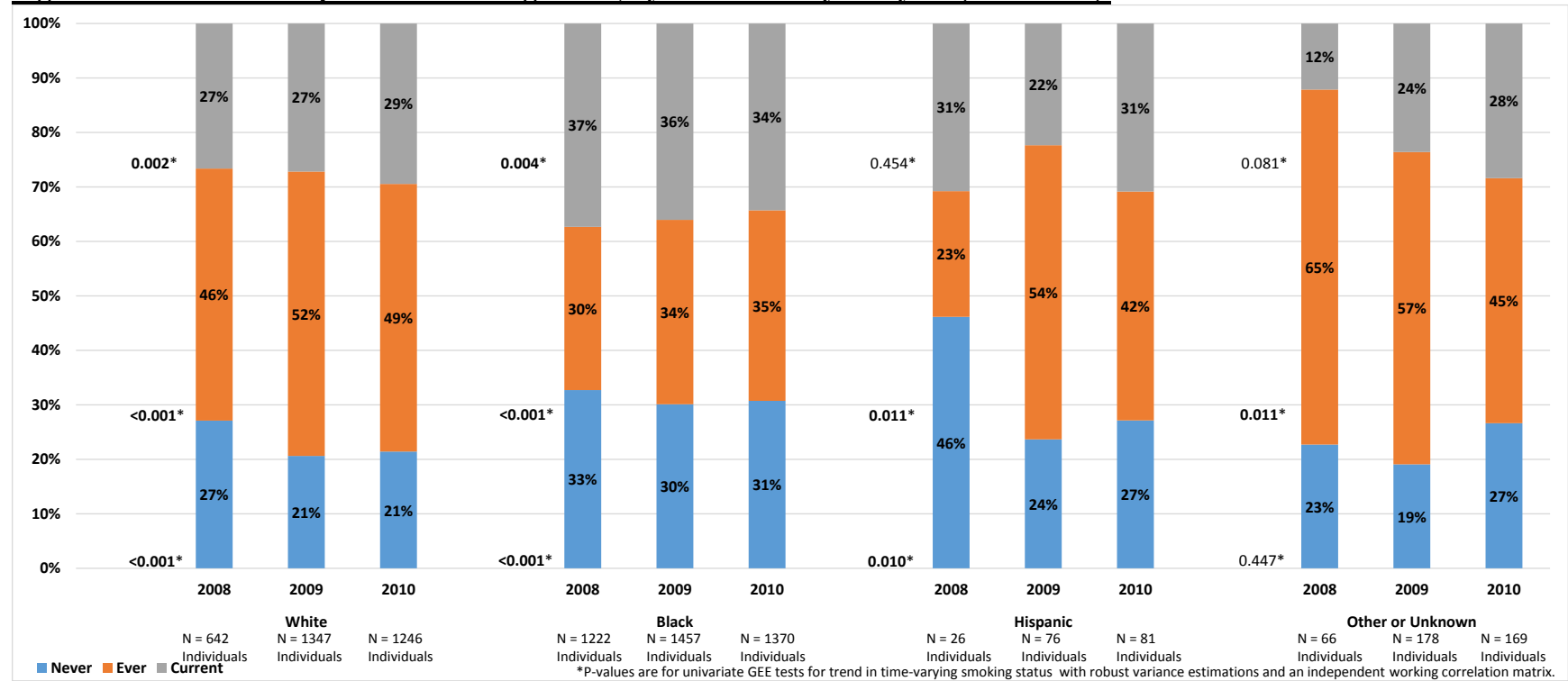
* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Figure 8. Distribution of patients' smoking status, by sex and year (2008-2010).



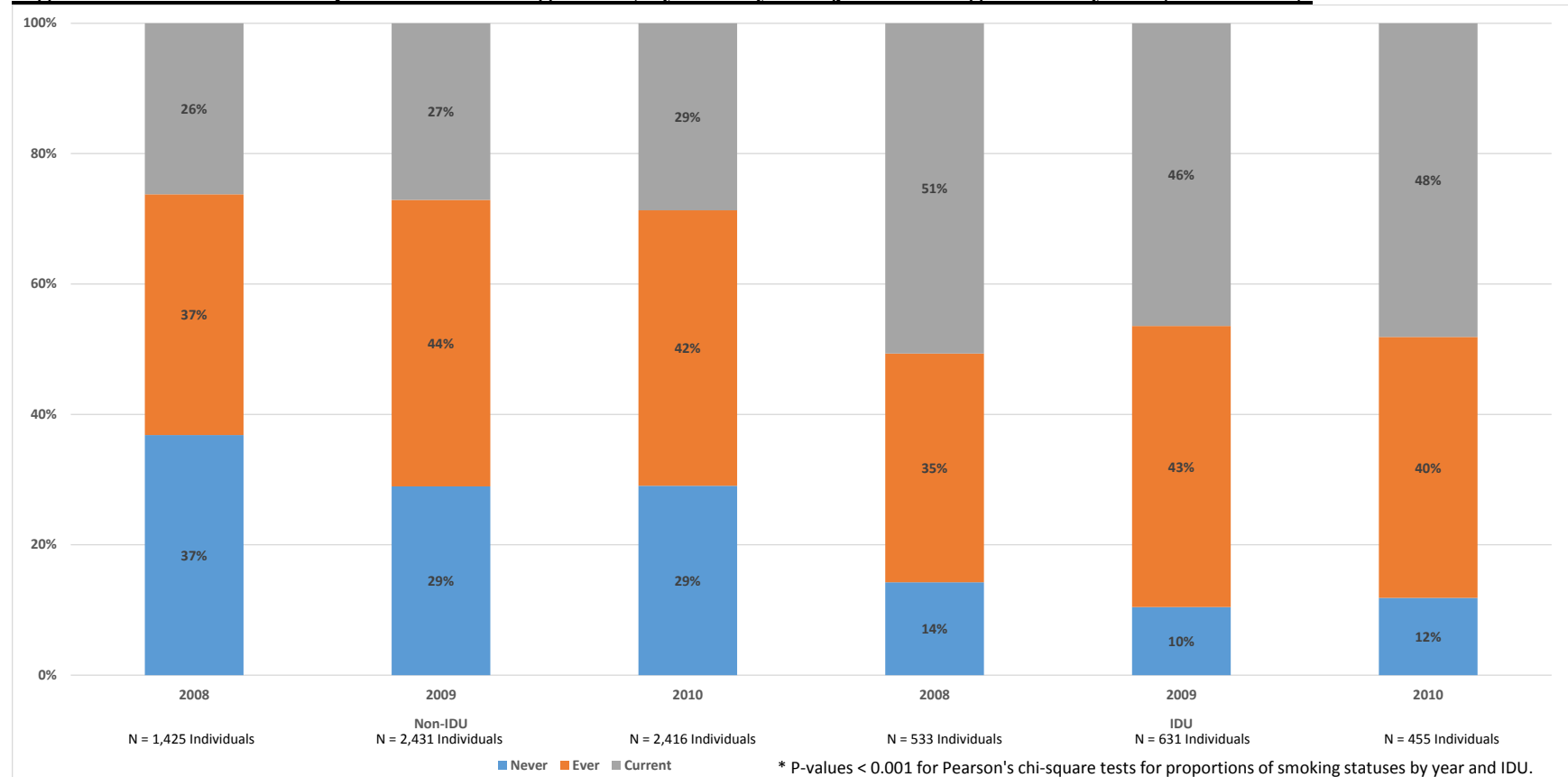
* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Figure 9. Distribution of patients' smoking status, by race/ethnicity and year (2008-2010).



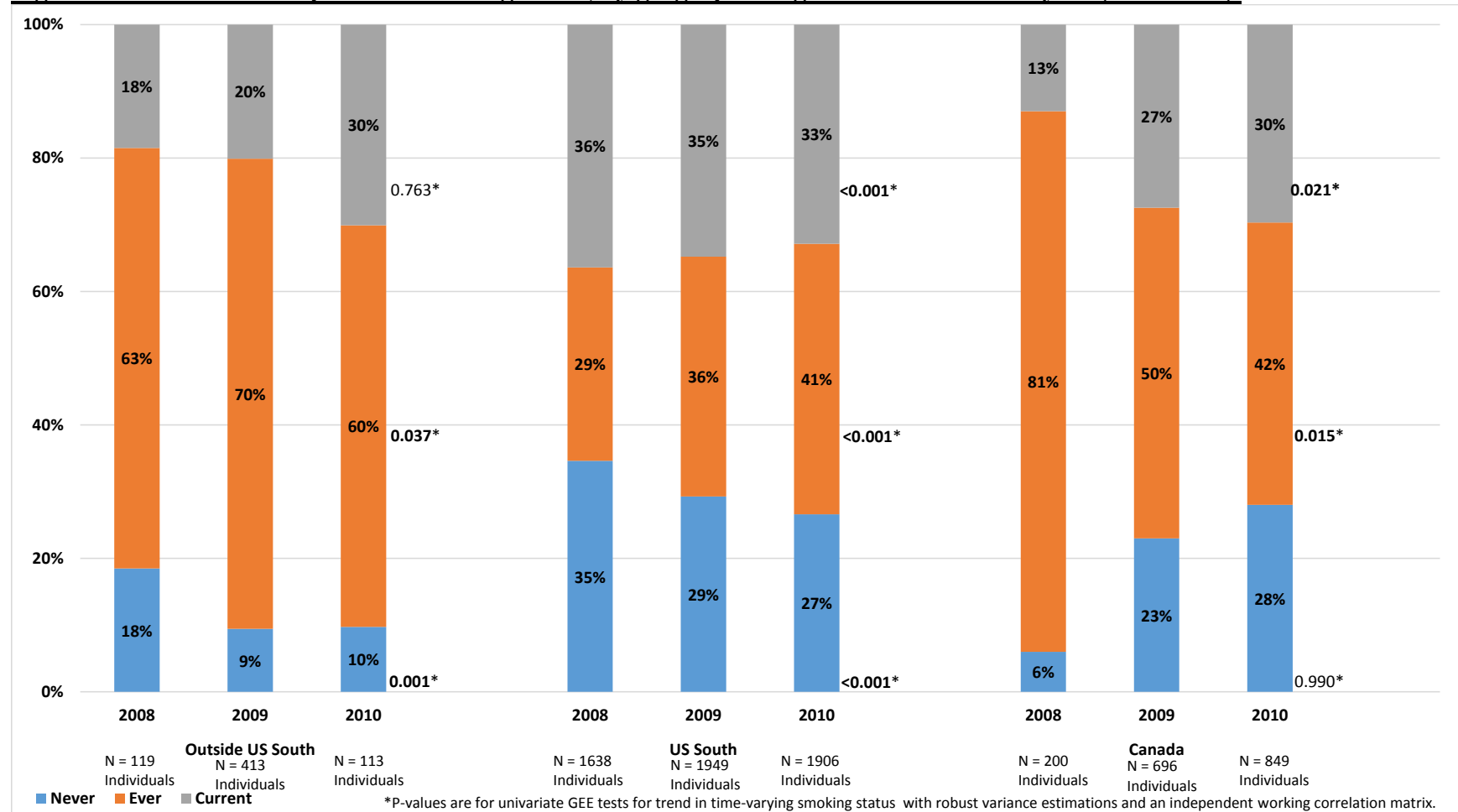
* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Figure 10. Distribution of patients' smoking status, by history of injection drug use and year (2008-2010).



* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Figure 11. Distribution of patients' smoking status, by geographic region of residence and year (2008-2010).



* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Figure 12. Smoothed hazard of failing to be retained in care over time, by smoking status (2008-2010).

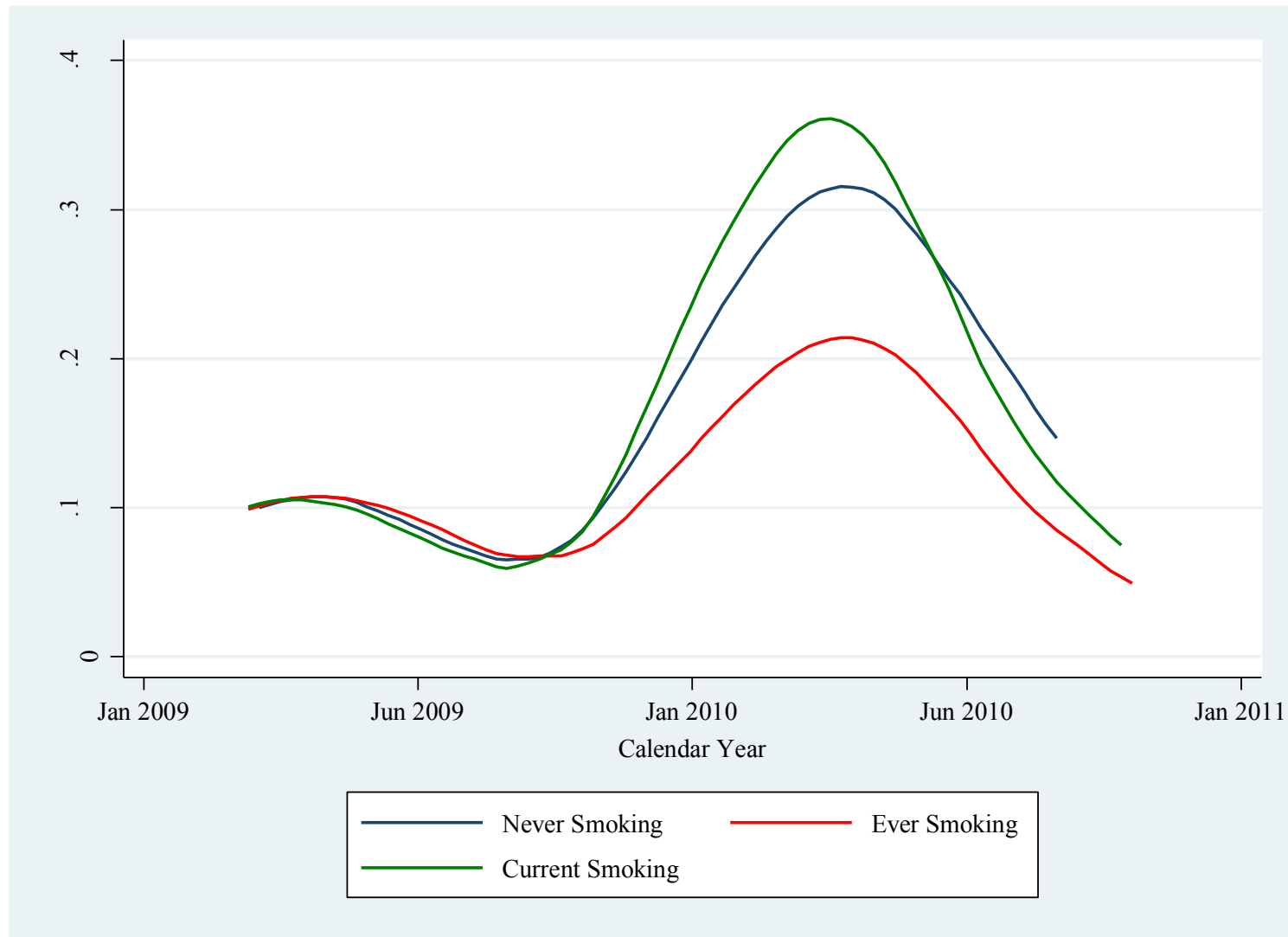
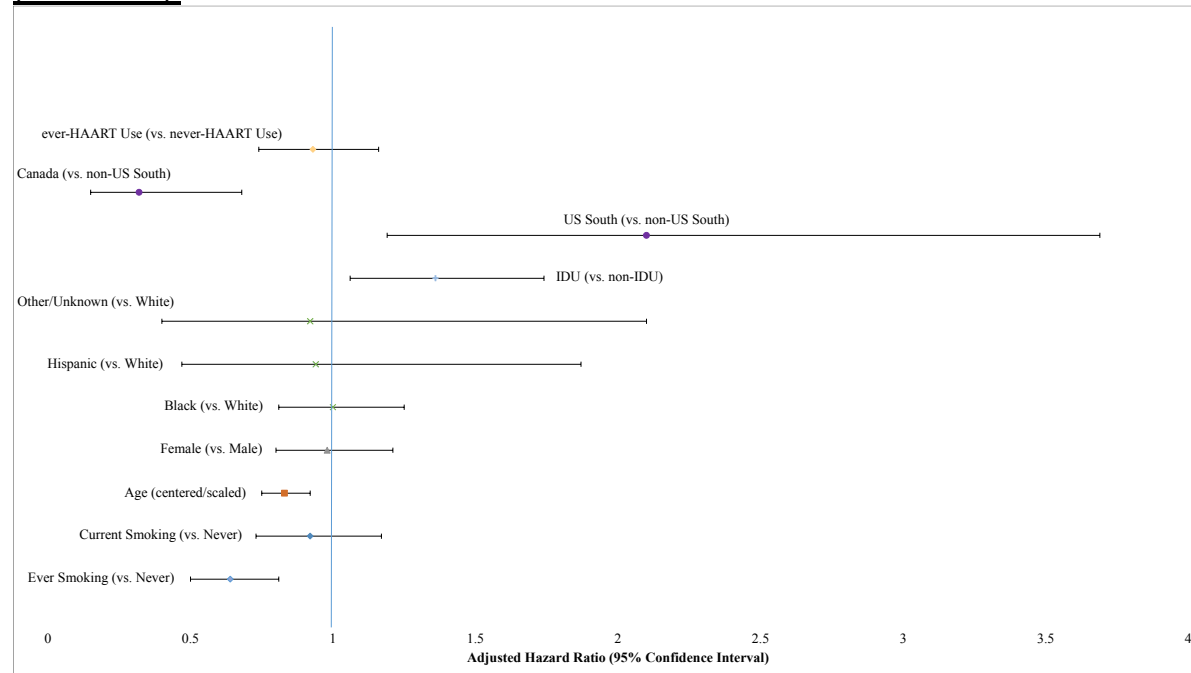
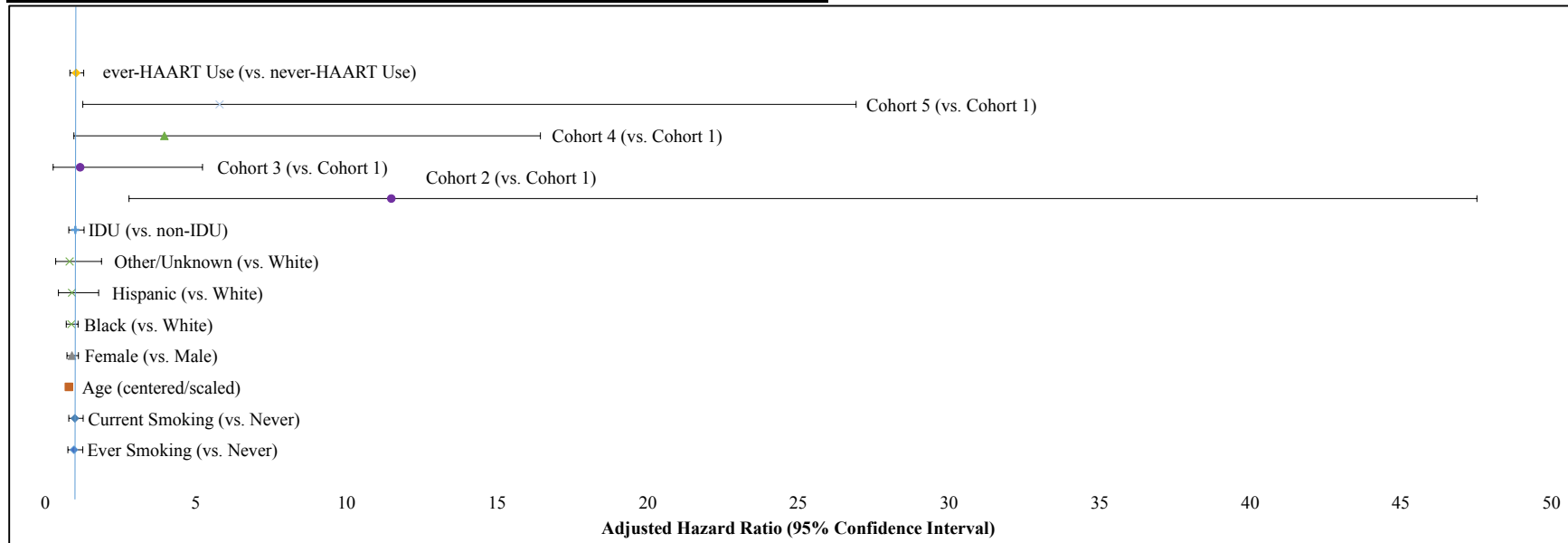


Figure 13. Forest plot of multivariate Cox proportional hazard model for failing to be retained in HIV primary care over time (2008-2010).



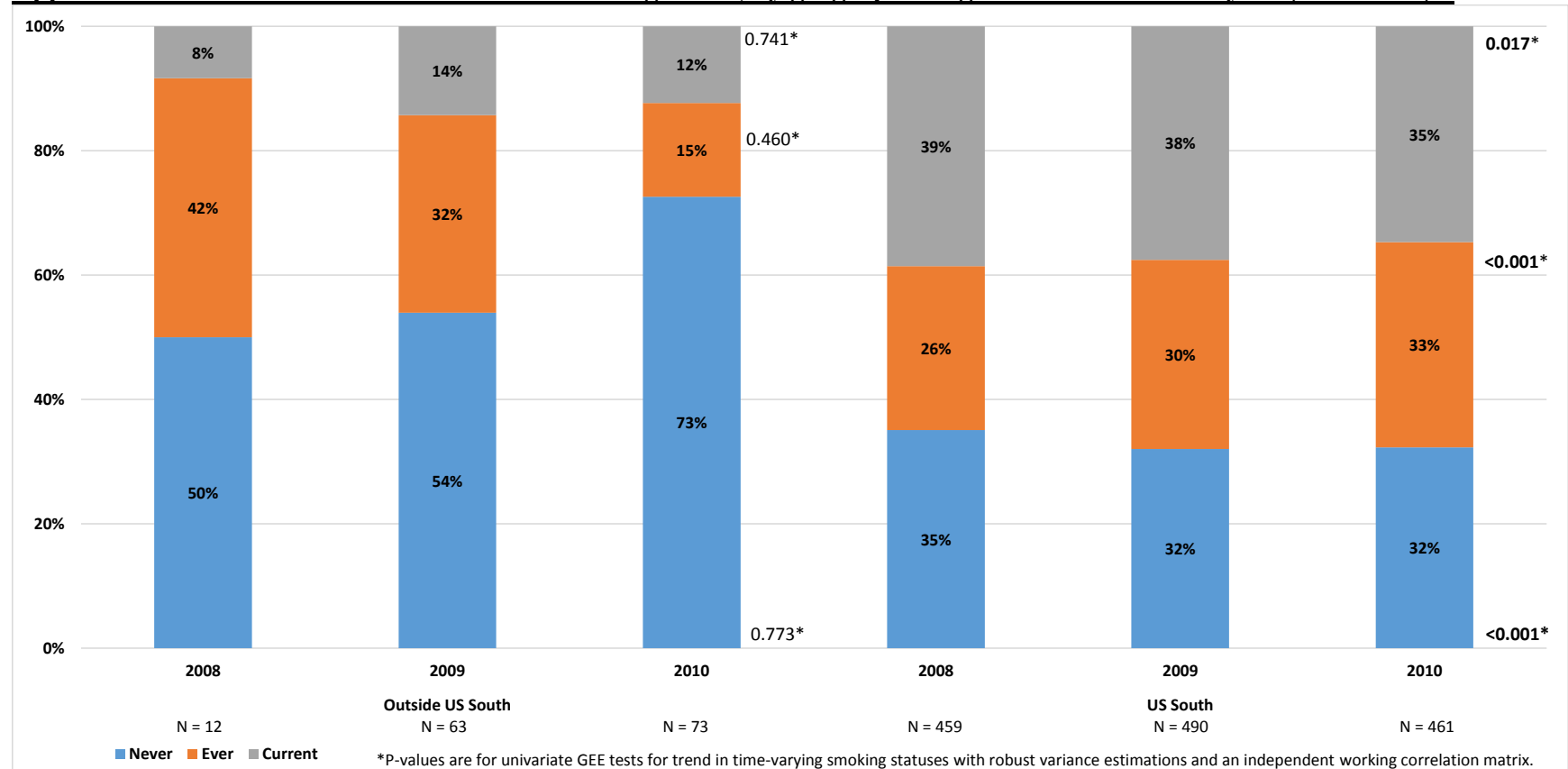
Variable	aHR	95% CI
ever-HAART Use (vs. never-HAART Use)	0.93	(0.74, 1.16)
Canada (vs. non-US South)	0.32	(0.15, 0.68)
US South (vs. non-US South)	2.1	(1.19, 3.69)
IDU (vs. non-IDU)	1.36	(1.06, 1.74)
Other/Unknown (vs. White)	0.92	(0.40, 2.1)
Hispanic (vs. White)	0.94	(0.47, 1.87)
Black (vs. White)	1	(0.81, 1.25)
Female (vs. Male)	0.98	(0.80, 1.21)
Age (centered at mean (45.71)/scaled by 10 years)	0.83	(0.75, 0.92)
Current Smoking (vs. Never)	0.92	(0.73, 1.17)
Ever Smoking (vs. Never)	0.64	(0.50, 0.81)

Figure 14. Forest plot of multivariate Cox proportional hazard model for failing to be retained in HIV primary care over time, substituting cohort for geographic region of residence (2008-2010).



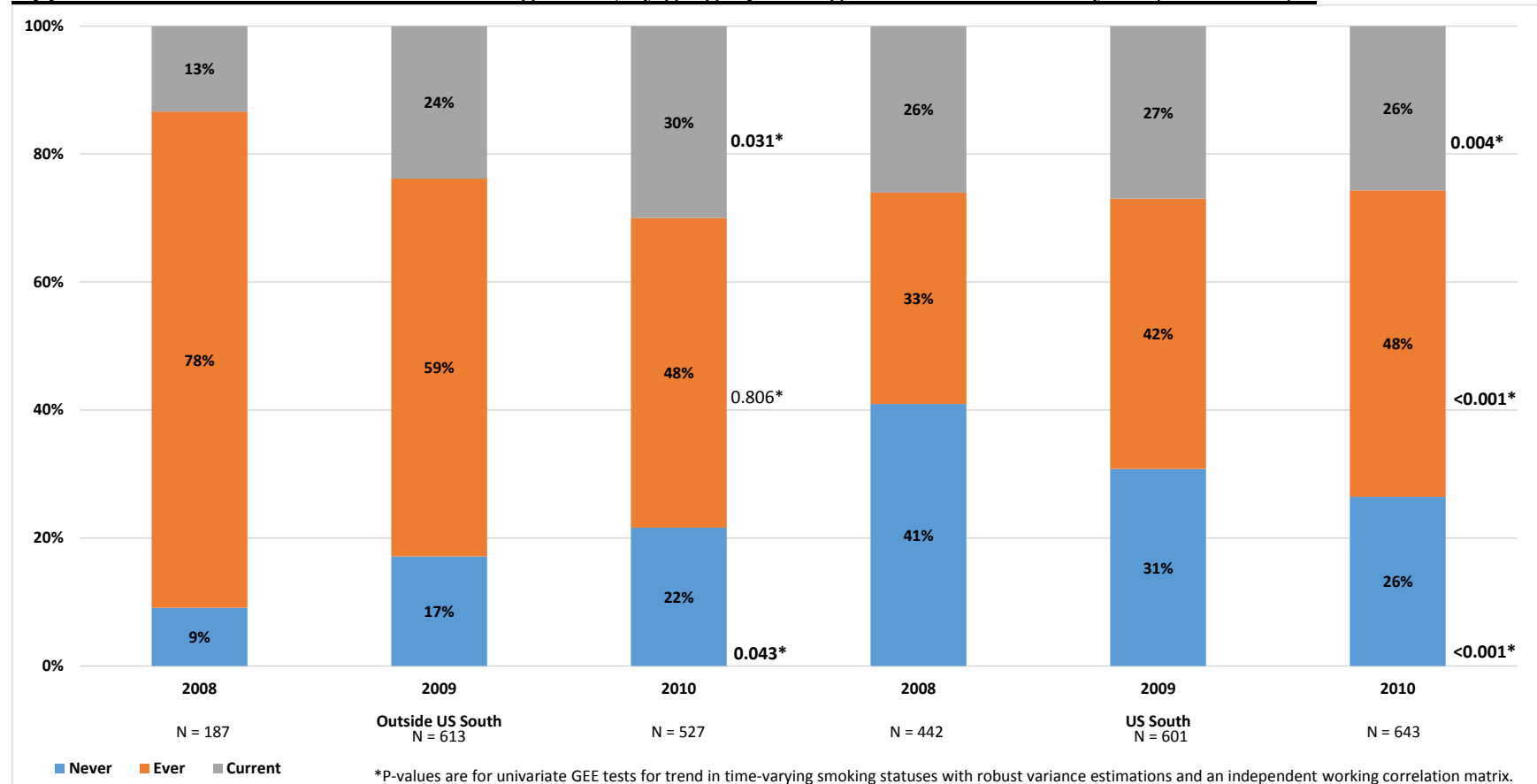
Variable	aHR	95% CI
ever-HAART Use (vs. never-HAART Use)	1.03	(0.82, 1.28)
Cohort 5 (vs. Cohort 1)	5.79	(1.25, 26.92)
Cohort 4 (vs. Cohort 1)	3.96	(0.95, 16.44)
Cohort 3 (vs. Cohort 1)	1.16	(0.26, 5.22)
Cohort 2 (vs. Cohort 1)	11.49	(2.78, 47.53)
IDU (vs. non-IDU)	1	(0.78, 1.29)
Other/Unknown (vs. White)	0.81	(0.35, 1.87)
Hispanic (vs. White)	0.89	(0.44, 1.77)
Black (vs. White)	0.87	(0.70, 1.09)
Female (vs. Male)	0.89	(0.72, 1.10)
Age (centered at mean (45.71)/scaled by 10 ye	0.79	(0.71, 0.81)
Current Smoking (vs. Never)	0.99	(0.78, 1.26)
Ever Smoking (vs. Never)	0.96	(0.75, 1.25)

Appendix A. Distribution of black women's smoking status, by geographic region of residence and year (2008-2010).*



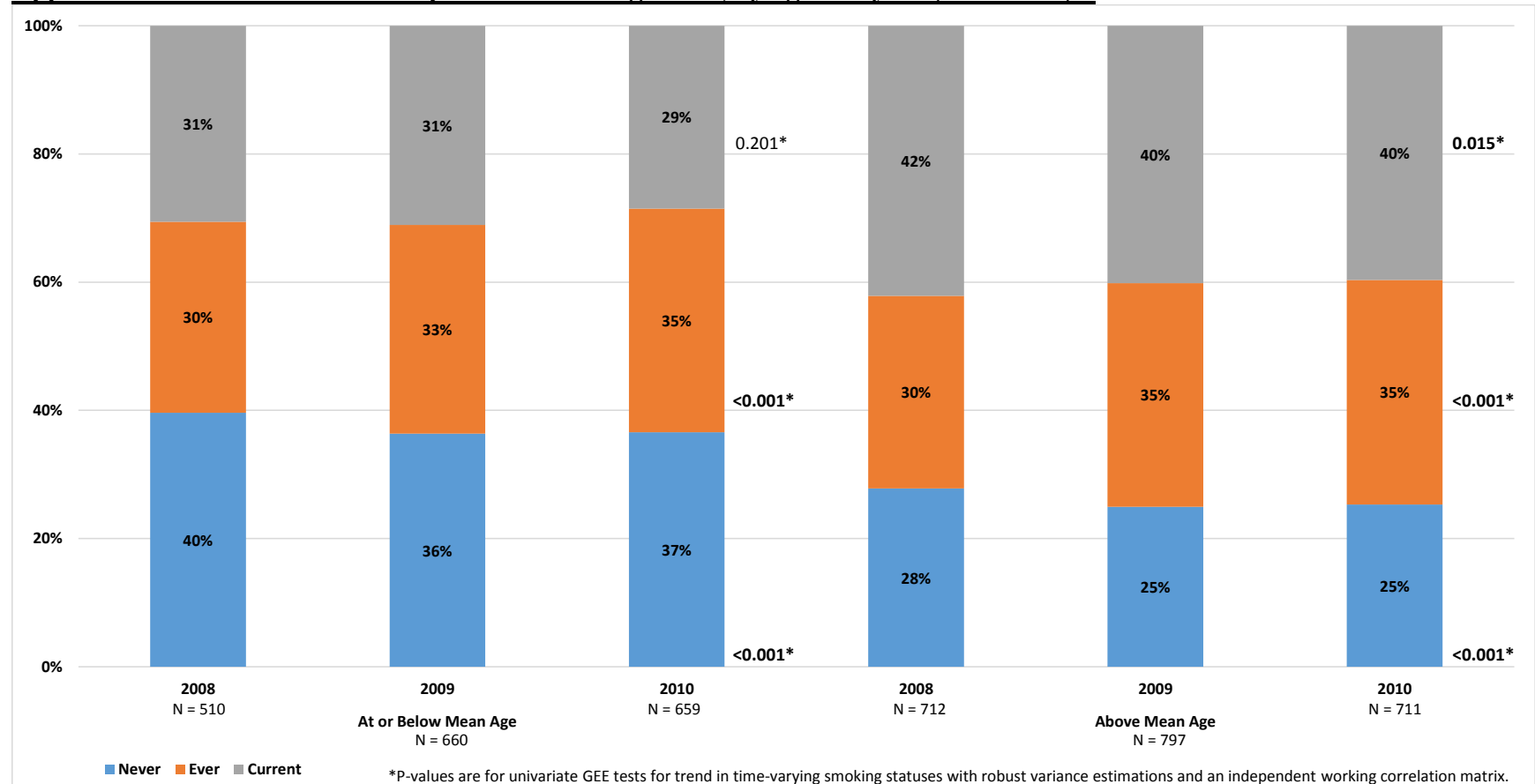
* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Appendix A. Distribution of MSM smoking status, by geographic region of residence and year (2008-2010).*

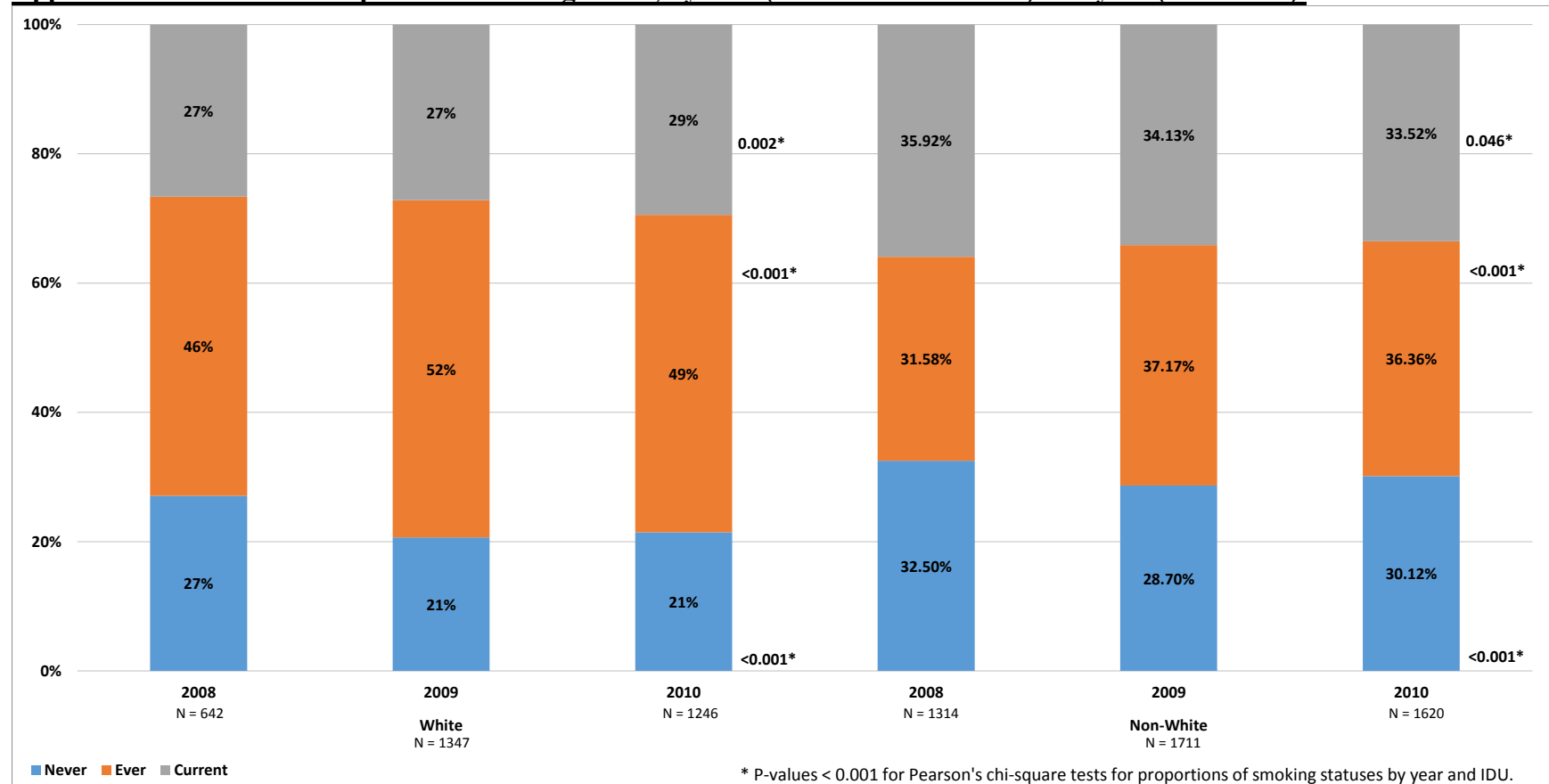


* Patients' smoking status was categorized as the heaviest smoking status reported in that year (current = heaviest).

Appendix A. Distribution of black patients' smoking status, by age and year (2008-2010).*



Appendix A. Distribution of patients' smoking status, by race (White vs. non-White) and year (2008-2010).



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PROFESSIONAL PROFILE

Research professional with background in HIV/AIDS, substance use, mental health, and non-AIDS related aging outcomes including cardiovascular disease and end-stage renal disease. Distinguished master of health science candidate in epidemiology and risk assessment with advanced knowledge in biostatistics, database management, and policy analysis. Prior job experience includes over five years of research coordination and data management/analysis within academic and non-profit settings, managing data collection, storage, and analysis at an organizational level, and ensuring concise and timely reporting of results to critical partners and funders.

EDUCATION

Master of Health Science, Epidemiology and Methodology

May 2014

Johns Hopkins Bloomberg School of Public Health

Master's Thesis: Trends in cigarette smoking and the relationship with failing to be retained in HIV primary care in the North American HIV clinical population, 2008-2010

Certificate in Risk Sciences and Public Policy

October 2013

Johns Hopkins, Bloomberg School of Public Health

Bachelor of Science, Psychology and Sociology

May 2009

University of Wisconsin, Madison

Honors:

- Member of Psychology National Honors Society 2006-present
- Undergraduate Research Scholar, 2006-2007

AWARDS, HONORS AND PROFESSIONAL AFFILIATIONS

- Membership Ambassador, American Public Health Association Student Assembly, 2013-Present
- Co-President-Elect, General Epidemiology and Methodology Journal Club, 2013-2014
- Committee Chair-Elect of the Epidemiology Student Organization, Johns Hopkins Bloomberg School of Public Health 2013-2014
- Organizational Representative of Hawaii Habitat for Humanity at the Hawaii State Legislature's Keiki Caucus 2009-2010
- Fundraising Committee Chair-Elect of the Psychology National Honors Society 2007-2009

RESEARCH EXPERIENCE

Graduate Research Assistant, North American AIDS Cohort Collaboration on Research and Design

Bloomberg School of Public Health, Johns Hopkins University

May 2013-Present

Primary Investigator: Dr. Richard Moore

- Lead an initiative in securing and creating user-friendly data sets from national Medicaid/Medicare data
- Conducted background research and produced literature reviews and research briefs
- Produced summaries and syntheses on algorithms to define outcomes using national Medicaid records
- Executed statistical analyses using SAS and STATA, including GEE, linear/logistic mixed effects regression modeling, and Cox proportional hazards modeling
- Wrote dataset cleaning code program and performed logic checks in Stata

Graduate Research Assistant, World Health Organization mTAG Consultative Meeting International Health Department, Johns Hopkins University

September 2012 - January 2013

Primary Investigator: Alain B. Labrique, MHS, MS, PhD, MACE

- Developed indicators to assess technological inputs at a client-level, provider-level, and health systems-level for mHealth solutions in various stages of development
- Conducted literature reviews of the WHO GRADE system, utilizing online research tools and databases
- Contributed to the drafting of documents prepared for the first WHO mTAG consultative meeting

Research Assistant, Problems in Human Behavior Research Lab, Psychology Department

University of Wisconsin-Madison

September 2007-May 2009

Primary Investigator: Patricia G. Devine, PhD

- Screened participants for eligibility, processed informed consents, discussed research, and conducted multi-stage experiments
- Trained and supervised first-year undergraduate research assistants on database management, experiment protocol, and response coding
- Compiled and maintained data using Microsoft Excel and SPSS
- Administered and catalogued mass psychological surveys to undergraduate psychology classes

Research Assistant/Undergraduate Research Scholar, Political Science Department
University of Wisconsin-Madison
2006 – September 2007

Primary Investigator: Georgia Duerst-Lahti, PhD

- Analyzed and coded recorded interviews using SPSS and Microsoft Excel
- Created a database and developed category analysis methodology using qualitative data
- Performed dataset cleaning and logic checks on code in SPSS
- Designed and maintained a codebook for current and future research members
- Conducted analyses for longitudinal study of associations between organizational elements and institutional conditions that foster and impede female executives as leaders

RELATED EXPERIENCE

Community Health Intern, The Center for Tobacco Use, Prevention, and Control
Maryland State Department of Health and Mental Hygiene

January 2013 - May 2013

- Analyzes cost-effectiveness data of Quitline and other tobacco cessation programs
- Develops webinar and in-person presentations to health care insurers, providers, and employers
- Creates promotional and social media material for evidence-based services
- Constructed program data reports, compiling/analyzing data relevant to grant applications and funders

Vice President of Social Media and Content Manager, Johns Hopkins Global mHealth Initiative

Student Initiative for mHealth Research and Innovation

September

2012 – September 2013

- Responsible for the production of all content on social media (Facebook, Twitter, YouTube)
- Wrote and edited press releases and promotional materials for website and social media distribution
- Maintained integrity of Twitter and Facebook feeds
- Trained and managed social media coordinators on writing and distributing press releases and social media etiquette using in-person instruction and pictorial user guides

Operations and Technology Administrator, Arthritis Foundation

October 2011 - August 2012

- Managed IT, local computer administration, upgrade, and repair
- Supported the staff of the Arthritis Foundation in technological development and maintenance
- Troubleshoot hardware issues with computers, copiers, phones, etc.
- Assisted with new technology acquisition and installation
- Wrote, verified, and distributed quarterly and year-end statistical reporting

- Prepared and distributed registration reports
- Overhauled assessment tools, modernizing data collection standards and reporting compliance

Community and Affiliate Relations and Fundraising Associate,

Hawaii Habitat for Humanity

August 2009 – August 2010

- Wrote and distributed policy briefs relating to housing and homelessness advocacy
- Constructed physical and electronic data collection forms
- Conducted surveys in order to assess the need for professional trainings for home building affiliates
- Developed promotional materials to be used at awareness and fundraising events
- Maintained, updated, and moderated a database for housing statistics specific to each home-building site
- Researched, organized, and published disaster preparedness kits for all home-building sites statewide
- Trained and managed AmeriCorps VISTA members on website maintenance

TEACHING EXPERIENCE

Teaching Assistant, Topics in Risk Assessment

March 2014 - May 2014

Johns Hopkins School of Public Health

- Instructed graduate students on proper evaluation and reporting strategies involving contamination events, both verbally and in print
- Lead discussions on evaluating and improving student participation in mock press conferences following an environmental disaster

Teaching Assistant, Stata Programming

March 2014 - May 2014

Johns Hopkins School of Public Health

- Trained graduate students in Stata commands necessary to data management (loops, macros, if/else statements, automating table/figure generation) and advanced graphing techniques
- Tutored graduate students in project workflow, procedural programming, and statistical analyses for capstone and thesis projects

Teaching Assistant, Introduction to Risk Sciences and Public Policy

January 2014 - March 2014

Johns Hopkins School of Public Health

- Supported student understanding of quantitative risk assessment and its application to the public policy process
- Led monthly webinars on contemporary case studies and considerations of social, economic, and political risk factors that affect risk decision-making
- Evaluated student written assignments, quizzes, and exams

Teaching Assistant, Risk Policy, Management, and Communication

October 2013 - December 2013

Johns Hopkins School of Public Health

- Trained graduate students in conducting case study analyses of health risk policies
- Designed and presented lectures, lead discussions, developed rubrics and graded assignments
- Supervised and advised students on written and oral testimonies in Congressional hearings

Teaching Assistant/Lab Instructor, Epidemiological Methods I

September 2013 - November 2013

Johns Hopkins School of Public Health

- Trained graduate students in epidemiological methods and study designs
- Instructed graduate students in use of Stata and MS Excel for statistical analyses
- Graded and critiqued student assignments

Faculty Assistant/Lab Instructor, Cultural Factors in Public Health

January 2013 - May 2013

Johns Hopkins University

- Created lesson plans on race, gender, and class influences on health and health policy to promote independent and group learning
- Lead discussions with students on current theories that seek to explain disparities in morbidity and mortality among US-based cultural groups

SAT Instructor

August 2010-January 2011

Kaplan Inc.

- Conducted twice-weekly lectures involving direct instruction, small group work, and independent study related to college-ready mathematics, essay-writing techniques, and verbal and linguistic development
- Enhanced instruction materials by integrating course-relevant games and activities into classroom discussion
- Advised students on college application processes, recommendation letters, and entrance interviews

CONFERENCE PRESENTATIONS

- **Johnson, A.** (2007, April). *Changing Gender, Power, and Leadership of Public Organizations: A Twenty Year Evolution*. Poster accepted at Undergraduate Symposium: Celebrating Research, Creative Endeavor, and Service-Learning, University of Wisconsin, Madison.
- **Johnson, A.** (2013, May). *Promoting Effective Tobacco-dependence Treatments in Health Systems*. Poster accepted at 10th Annual DHMH PHASE Symposium: From Theory to Practice, Maryland State Department of Health and Mental Hygiene.

TECHNICAL SKILLS

- SAS, Stata, SPSS, GIS, R, JavaScript, Crystal Ball, Blackbaud fundraising and CRM software, PubMed, MS Office Suite, Allscripts EHR, Medflow, ConnxtMD, website design and maintenance, Facebook, Twitter, and YouTube management